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NOTES AND COMMENTS.

The Botanist of the Future.

"BOTANICAL OPPORTUNITY" is the title of Professor Wm. Trelease's presidential address delivered to the Botanical Society of America, and reported in full in the September number of the *Botanical Gazette*. As the president addresses himself to "the large and growing number of young botanists" who are seeking help and inspiration, and as his remarks will apply almost equally well to other branches of science, it may be worth while to call the attention of our readers to some of them. The present is a period of transition. A generation ago it was possible to accumulate wealth in commerce, and also to devote much time to the study of nature. "To-day the man who is not entirely a business man is better out of business, and, with a few exceptions, the man who is not entirely a student is little better than a dilettante in science."

Professor Trelease is sanguine; he predicts that even in the next decade, the money-makers will realise the tremendous advantages to be gained by the encouragement of pure science, and adequately endowed laboratories of research will "stand out quite alone, and justify their existence without reference to other ends." Take heart, Cinderella, the prince is coming!

The subject is considered under two heads,—the opportunity of institutions and of individuals. That of the former lies in equipment and the use thereof, and useful hints are given as to the proper limits of library, herbarium, garden, and apparatus. The great expense attached to a garden, and the impossibility of growing more than a very limited number of plants, and also of imitating successfully different climatic conditions, leads to the suggestion of establishing branch gardens, where plants characteristic of special sets of conditions, such as alpines, maritime plants, succulents, etc., can be studied in their native environment. Moreover, the institution of the future

"will count as a part of its legitimate equipment the provision, as needed, of very liberal opportunities for the staff to visit even distant regions for the study in their native homes of plants which cannot be cultivated even in special gardens in such a manner as to be fully representative"; and some provision will be made for enabling students to utilize new centres of research "without encroaching too far on the limited savings from the small salaries which, as a rule, are drawn by the botanists of the country." And "it is quite certain that within a very few years opinion will have so changed that a considerable number of salaried positions for research work or applied botany will exist," which positions "will compete with the professorships in the best universities," &c. Utopia! And the scientific members of the Staff at Kew Gardens will be provided with suites of rooms at Hampton Court!

Turning to the individual, the speaker reminds us that it is to slow and persistent investigation, rather than to sudden inspiration, that we must look for the accomplishment of the greatest collective results. He points to the necessity of breadth of early training; powers of observation must be well developed, and more discipline in reasoning given than is now customary. After the selection of a subject nothing is so important as system in pursuing it. We can see in others, if not in ourselves, a great waste of energy, resulting from shiftless and ill-considered methods of procedure. "Order and method are absolutely necessary, and next to the clear idea of the end aimed at, I should place immediate making of full and exact notes as their most essential part." Finally, manner of publication is considered. Writers are warned against the habit, especially common in the earlier years of their work, of distributing their papers among a number of journals. Provided they are on kindred subjects, they should, of course, be kept as closely associated as possible when published, so that in seeking one a reader is likely to learn of another.

THE STUDY OF VARIATION.

IN our September number, under the heading "A Registry Office for Snails," we ventured some remarks suggested by a Label List for variations in banded snail-shells, sent us for review by Mr. John T. Carrington. Mr. Carrington is very angry, so angry that, in a reply extending over five columns of his own magazine, he brands us as "closet naturalists" and "Superior Scientists," the latter expression being in his opinion particularly "objectionable." We cannot, however, regret our note, since it has drawn from Mr. Carrington an explanation that really is of interest. After all it seems that he really is trying to correlate the existence of these variations with the character of the localities in which they are respectively abundant, and he finds that he can "by change of food and other means alter the band formula of an individual, I think I may say, at

will." He wishes to find out what occurs in a state of nature, and especially what does not occur, and his object in having the list printed was that he might send it round, for their local census, to the very few people in this country and on the Continent who collect these band forms. Mr. Carrington also points out that the study of variations has proved of great importance in the hands of Darwin and Bateson. This is admirable. This is precisely what we hinted was necessary. But of all this there was no suggestion in the preface that was attached to the "Label List." What we objected to was not the scientific study of variations, but their *meaningless* collection and record, and, above all, the misleading habit of attaching varietal names to variations which may, it is true, be constantly repeated, but which have not been proved to exist as separate and continuous races. On this question Mr. Carrington has a paragraph which is unintelligible to us; we regret our obtuseness the more since the paragraph appears to be of a sarcastic nature. We can only gather from it that the Editors of NATURAL SCIENCE and of *Science Gossip* use the word "variety" in different senses; which of them is right it would ill become us to decide.

THE USE AND ABUSE OF COLLECTING.

STILL addressing us as the "Superior Scientist," Mr. Carrington hints that we are casting wet blankets on young naturalists, deterring them "from pursuing lines of thought and investigation which are really unworked"; that, in short, we desire the extinction of the field-naturalist. Our regular readers, of whom Mr. Carrington is obviously not one, will recognise the absurd injustice of these aspersions. From the leading article on "Private Collections," on p. 161 of our first volume, down to the note headed "Natural History *versus* Systematic Work," on p. 4 of this volume, we have been perfectly consistent in urging the importance of observations in the field and the value of the collecting spirit when directed along proper channels; we have even, strange though it may seem to Mr. Carrington, insisted more than once on the necessity for the detailed and systematic collection of those minute variations which *Science Gossip* loves to call varieties. What we have protested against has been the restriction of a man's energies to mere collecting, often indiscriminate and harmful in its effects on the flora and fauna, covetous of rarities and show-specimens, and rarely paying attention to larval forms, food, or bionomic considerations. Why was it for thirty years "the custom of the 'superior entomologist' to sneer at British butterflies and their collection"? Simply because the ordinary "bug-hunter" did *not*, and did not even wish to, pay attention to their life-histories, to their comparative structure, or to the various points that made Mr. Scudder's work what Mr. Carrington calls it—"really scientific." Even now there are entomologists—we do not know whether they

are too "superior" for Mr. Carrington—who think that "the wholesale formation of collections should be discouraged as much as possible" (*Nature Notes*, October, 1896). When we find such men as Professor Meldola, Mr. McLachlan, Mr. J. W. Tutt, and Mr. W. F. Kirby all in a tale together, we are not ashamed to be of the company. Let us not misunderstand one another! Let *Science Gossip* continue to inculcate the true principles of scientific collecting, let it above all things encourage observation, and discourage petty nomenclatorial propensities, and it will meet with not merely patronising approval, but all possible help, even from the Superior Scientist.

BRITISH SNAILS.

YES! Mr. Carrington, even the variations of snails may be studied to good effect, as shown by a paper on an early neolithic kitchen-midden and tufaceous deposit at Blashenwell, near Corfe Castle, which Mr. Clement Reid has had published in the *Proceedings* of the Dorset Field Club, vol. xvii. Twenty species of snails are recorded by Mr. Reid from the tufaceous deposit; "all species still inhabiting Dorset," and the list is "more striking from the absence of so many of our commonest living species than for anything else." The chief interest is seen in the well marked distinction between *Helix nemoralis* and *Helix hortensis*, so marked indeed that Mr. Reid says "no naturalist seeing a large series from Blashenwell, and unacquainted with the variability of the living snails, would for a moment hesitate to say that they were good and well-marked species, belonging merely to the same section of the genus." The following diagnoses are given:—

H. nemoralis.—Shell large, depressedly globular, amber coloured or yellow, without bands, lip dark.

H. hortensis.—Shell smaller and more globular than *H. nemoralis*, whitish, bands five, two narrow above and three broader below, often widened till they become confluent, lip white.

The difference is not due to deficiency of colour, for, as Mr. Reid says, the dark tipped *nemoralis* is always amber-coloured or yellow, but entirely without bands, while the smaller white-lipped *hortensis* is whitish or grey and five banded, only a single specimen out of hundreds having one of the narrow bands missing. The banded *nemoralis* so common at the present day is wanting at Blashenwell, as are all intermediates or hybrids between the two forms.

Mr. Reid also calls attention to the fact that land shells are likely to be extremely valuable guides to the age of a deposit, and mentions that he has never seen in any deposit, satisfactorily shown to be older than the Roman invasion, any specimen of the common brown snail of our gardens, *Helix aspersa*, and he urges archæologists to collect land snails from the graves in the Downs.

N.Spp.?

We have for the greater part of this year been protesting, both in season and, as some of our readers think, out of season, against that irritating form of scientific vanity known as the preliminary notice. Our protest was originally drawn forth by a regrettable publication in the *Circular* of the Johns Hopkins University from the pen of an excellent American geologist. But his rival has now appeared in our own country, and a greater offender arises in the Geologists' Association. We should like very much to know what particular obliquity of judgment it was that led the well-known gentlemen who form the council of that thoroughly praiseworthy association to publish in the August number of their *Proceedings* (issued September 4, 1896) "A Preliminary Synopsis of the Fauna of the Pickwell Down, Baggy, and Pilton Beds: by the Rev. G. F. Whidborne, M.A., F.G.S." We do not propose on the present occasion to discuss the accuracy of this gentleman's work; we do not propose to repeat for his edification, or for the benefit of the Geologists' Association, the invectives that we have already launched at the heads of workers and societies of even greater reputation; but we confine ourselves to the most succinct statement possible of the facts of the case.

The paper occupies seven pages: it consists of a list of 187 names of fossils, most of them without added remarks, but many placed (no doubt wisely) between inverted commas or in front of a note of interrogation. Seventy-five of these names, however, are stated to belong to new species. Of these seventy-five new names, two are absolute *nomina nuda*. Five others are equally unprovided with any attempt at a diagnosis, but have references to figures in Phillips' "Figures and Descriptions of the Palæozoic Fossils of Cornwall, &c." The remaining sixty-eight are followed by sentences which only courtesy and convenience permit us to designate as diagnoses. No figures are given. We quote at random a few examples of the diagnoses:—

"*Anatifopsis* (?) *Anglica*, n.sp., like *A. acuta*, Barr., but shorter.

"*Ceratiocaris* (?) *subquadrata*, n.sp., large sub-oblong valves with ogee end.

"*Orthoceras Barumense*, n.sp., very like *O. ibex*, Sow., but without longitudinal striæ.

"*Scaldia* (?) *longa*, n.sp., small, smooth (?), transversely ovate, with sub-central umbo.

"*Athyris rugulosa*, n.sp., large, with wide flattened fold and numerous imbricated foliaceous striæ.

"*Camarella togata*, n.sp., with three large ribs on fold.

"*Rhabdomeson* (?) *distans*, n.sp., dichotomizing witth (*sic*) fewer and more distant zoæcia (*sic*), with oval apertures.

"*Cornulites devonianus*, n.sp., small, elongate, conical, slightly flexuous, with few step-like annuli.

"*Taxocrinus* (?) *stultus*, n.sp., with 3 B, 5 R, and intercalated anal, and with IBr. in three rows.

"*Prothyris recta*, n.sp., small, sub-oblong, coarsely striated."

It is stated on the wrapper of the *Proceedings* that this paper was first published in the Long Excursion Pamphlet. The date of this is not given, but we understand that a very limited number of copies was issued. A note at the end of the paper states that the author "is at present describing the above species in a Monograph of the Palæontographical Society." A portion of that Monograph has since appeared, and we are not surprised to find many of these so-called new species again figuring as "n.spp."—for such is the usual custom of the preliminary speciesmonger, who, having secured what he calls "priority" by his precious leaflet, carefully ignores it in all his subsequent writings. Casual comparison of the preliminary list with the Monograph reveals a strange discrepancy: "*Anatifopsis ? anglica*," is now said to differ from *A. acuta* "in being much more elongate." Moreover matters are not made much better by the publication of figures of some fifteen of these so-called new species without accompanying text. From some enquiries we have made, we gather that in the present case the author was not altogether responsible for the publication of what he wished to be regarded as a manuscript list. This may throw the blame on to other shoulders, but it does not make matters better for the working naturalist. And as for the Palæontographical Society, its fifty years should have taught it better.

THE REDUCTION OF PUBLICATION.

THOSE who sympathise with the remarks that we have had occasion to make on the preliminary publication of incomplete work, will read with interest the following sentences by Mr. Charles R. Keyes in a review, published in *Science*, of volume v. of the Iowa Geological Survey:—"As in the previous volumes of this survey there is carried out the highly commendable policy, established at the beginning, of eliminating all matter from the reports that is of a preliminary nature, and of publishing only material that has been carefully digested and classified. In this way the total amount of matter published is not nearly so great as it otherwise would be. With great advantage all work of preliminary character, which so often goes to make up the large bulk of geological publications, is omitted. Thus, only the work in its ultimate form is made public. The set of volumes becomes the 'final' series, and only a single class of publications is issued."

We also welcome the co-operation of the *Botanical Gazette* which, *à propos* of the duplication of publication, remarks:—"If we are not mistaken, the publication of one paper stating fully the nature and results of a research ought to end publication until further research

has been made and new results reached. Some eminent botanists have in late years followed a different course, and have worked over the same studies into three or four different papers in different journals. But if results are of real value one adequate publication is all they need to receive recognition and all that ought to be unloaded upon already burdened bibliographers. We go so far as to say that the 'preliminary paper' with its half prepared diagnoses or ill-digested generalisations is an unmixed evil and ought to be suppressed by botanical opinion. We are glad to join *Natural Science* in its vigorous opposition to such makeshift methods."

"Drunken with Writing."

That was the picturesque phrase, descriptive of the present intellectual position of civilised man, with which Professor Flinders Petrie gained the hearty applause of those who heard his Liverpool lecture on "Man before Writing." The position and importance of writing, in contrast to the teaching through the senses, has been so much overvalued that it has deadened the growth of the mind. This mistake is like that which the Greeks made regarding language, in supposing that words could be used as an algebra to reach the reality of mind and of matter. Thought, however, is independent of words, as is most plainly shown by the difficulty of finding words to express thought exactly. As thus words have been formerly mistaken in their function, so writing has been until very lately also mistaken as the means of growth of the mind. The earliest writing, before the mind of man was deadened by convention and imitation of past literature, is the finest, as seen in the Homeric and other epics of each land. That expresses the mind of man before writing. And literature only lives by continual absorption of the unlettered man as material for new growth. Each stage of literature in Greece and in England has been a using up of a fresh stratum of man without writing. And as literature requires to grow on the facts and feelings unconventionalised, so history requires to grow on the facts as discovered, either with or without writing, but independent of any version of it written down. The tangible facts of man's art, life, constructions, follies, and magnificence, form the reality of history. Such history can be gathered as well from man before writing as from written accounts.

The nature and ability of man before writing can be seen as regards his mind in the earliest literature, which is confessedly the finest and most vivid. For his art, we see it in the magnificent vigour and ability of the Mycenæan art, as shown on the gold cups of Vapheio and the ornaments from Mycenæ, and on the architecture of Tiryns and Mycenæ. And the grand ability of these is akin to the spirited and natural carvings of animals done by the cave men of

France and England, and is therefore not by any means a solitary test of unlettered man.

The splendid figures of the Dacians, conquered by Trajan, give a view of the noble air and expression of man before writing in that region.

Egypt, as Professor Petrie has done so much to show, presents us with an epitome of the civilisation of unlettered man in the figures of various objects used as hieroglyphs, since they must have preceded the use of writing. These show that in that stage man had fully developed weapons, tools, boats, ornaments, and architecture.

Thus the civilisation, art, ability, and conceptions of man before writing are quite on a level with what he used afterwards. Writing is like railways and telegraphs, one of the tools which we must use to hold our place with others; but it is of no virtue to the mind in itself. And by relying on it too much we lose that education of the senses, and the growth of the mind through the senses, which is the most really important for us.

Was it, we wonder, this lecture, that suggested to Dr. W. Essex Wynter his recent address to the students at Middlesex Hospital, in which he advocated a study of concrete facts rather than of books? At any rate, we ourselves as we heard it were profoundly impressed with the truth of those remarks as applied to the study of science. The beginner, we fear, is often expected to know what Professor X., Dr. Y., and Mr. Z. think about, say, *Balanoglossus*, though his own practical acquaintance with the animal remain of the most meagre description. Even when practical work is insisted upon, it is accomplished with the aid of manuals, text-books, diagrams, and pretty pictures. Originality of observation, nay, the very power of independent observation, is thus checked. Give a man an object, whether a tea-plant or a tea-cup, and make him describe it; take him to a quarry, and make him measure, sketch, collect, note, and label; all this without books, without names, without the obscuring jargon of the "ologies," and you will have done more for his training as a scientific naturalist than by a month of lectures on the ancestry of the Chordata.

MYCENÆAN CULTURE.

IN his presidential address to Section H, entitled "'The Eastern Question' in Anthropology," Mr. Arthur Evans alluded to the continuity of race from Palæolithic times, as evidenced by the remains in the Baoussé Roussé Caves, through Neolithic skeletons of the same Ligurian coast, down to the historical Ligurian type. Thus the 'Mediterranean Race' finds its first record in the West, and may date from the time when the land bridges of Eurafrica were still unbroken. The continuity of cranial type has been emphasised by Professor Sergi, and Salomon Reinach has brilliantly advocated the indigenous nature of the early European civilisation. The earlier civilisation of

the Bronze Age is that of the Swiss Lake settlements, the later is known under the general term of 'Ægean.' The latter roughly falls into two divisions, an earlier, represented by the cist graves of the island of Amorgos, and a later, the Mycenæan. The Amorgan period exhibits abundant proof of a widespread commerce from Spain and the Libyan coast to Chaldæa. Characteristic of the art of this period is the returning spiral, which undoubtedly was borrowed from Egypt and by the trade of this civilisation it spread into Scandinavia and as far as Ireland; but there was probably a southern route along the Mediterranean to the latter island, and it is on this line, rather than on the Danube and the Elbe, that we find in a continuous zone that Cyclopean tradition of domed chambers which is equally illustrated at Mycenæ and at New Grange. In the matter of the spiral motive, Crete may be said to be the missing link between prehistoric Ireland and Scandinavia and the Egypt of the Ancient Empire. The President announced his discovery of a prehistoric Cretan script excavated from the lowest level of a Mycenæan stratum, thus the great step in the history of writing implied by the evolution of symbols of phonetic value from primitive pictographs is shown to have effected itself on European soil. Mycenæan culture was permeated by Oriental elements but never subdued by them. It is difficult to exaggerate the influence of this widely ramifying Mycenæan culture on later European arts from prehistoric times onwards. Beyond the limits of its original seats, primitive Greece and its islands and the colonial plantations thrown out by it to the west coast of Asia Minor, to Cyprus, and in all probability to Egypt and the Syrian coast, we can trace the direct diffusion of Mycenæan products, notably the ceramic wares, across the Danube to Transylvania and Moldavia. The Mycenæan impress is very strong in Southern Italy and Sicily, isolated relics have been found in Spain and even in the Auvergne. In Bosnia and Herzegovina a sub-Mycenæan influence affected the Early Iron Age. These Mycenæan survivals and Illyrian forms engrafted on the "Hallstatt" stock were ultimately spread by the conquering Belgic tribes to our own islands, to remain the root element of the Late Celtic style in Britain, where the older spiral system had long since died a natural death, and in Ireland to live on to supply the earliest decorative motives of the Christian art of that country.

Geological Time.

Professor Poulton's interesting address to the Zoological Section discussed the possibility of evolution within the allowable limits of the earth's age. Biologists would probably have preferred a summary of recent work on the problems of insect coloration, which the zoological President could have discussed with unique authority; but in this age of specialisation it is seldom that the difficulties thrown in the way of zoological progress by sister sciences can be attacked by men

who are authorities on more than one. Professor Poulton is a geologist as well as a zoologist; he was, therefore, doubtless wise in choosing a subject which depends on the evidence of both sciences. His text was one of the arguments used by Lord Salisbury at Oxford. It may be remembered that the Premier, in his Presidential Address, claimed that the limitations placed on the age of the earth by Kelvin and Tait were a proof that evolution had been physically impossible. Evolution demands many hundred million years; physics prove that no more than ten or a hundred million years can be allowed. This conclusion has recently been attacked by Professor Perry, who has shown that of the three arguments on which it once rested, the only one to which any weight was still attached is utterly valueless. He has shown that Lord Kelvin's case rests on a series of assumptions, which are not only unproved, but of which the truth is almost impossible. Professor Poulton quotes Darwin to the effect that "Thomson's views of the recent age of the world have been for some time one of my sorest troubles," and that to his mental vision their author was "an odious spectre." In this judgment Darwin was truer than he knew; for Perry's examination of Lord Kelvin's assumptions has shown that Darwin troubled himself needlessly; the argument, as mathematically stated, is at first sight as unintelligible and alarming as a spectre, but it is as harmless. Perry's position is based on mathematical reasoning, of which the principles are simple, but the language obscure to the non-mathematical mind. Professor Poulton has done a useful service by summarising the controversy in non-technical language which anybody can understand.

The second part of the address considers the biological evidence in support of the geological view of the immense antiquity of the earth. Professor Poulton's thesis is that the evolution of the ancestor of each of the higher animal phyla probably occupied a very long period, and that the time required for the evolution of the separate phyla from their original common ancestor can only be expressed as the period represented by all the fossiliferous rocks multiplied many times over. He points out that in the Cambrian period most of the hard bodied phyla were represented, and that in most cases, *e.g.*, the echinoderms, they were as distinct and separate as at present. He therefore demands a prodigious period of time before the Cambrian, during which life was slowly evolving. That he is right in his main contention no geologist is likely to deny, although when we come to his individual arguments we may doubt whether some of his estimates are not exaggerated. Even if we were to accept the exceeding slowness of evolution that finds favour with Professor Poulton, we might still maintain that it advanced far more rapidly in pre-Cambrian times, for groups in their youth vary more than in maturity, though perhaps less than when in decay. Brooks has suggested causes as likely to have accelerated the early development of the phyla, which, when once well established, remained remarkably stable. Hence, we

may not hope for a reliable estimate of the length of the pre-Cambrian period from zoology any more than from physics. We may at least be grateful, when comparing Professor Poulton's cautious generalities with the statement of some physicists, that no attempt to hamper progress by impossible precision is likely to be made.

Palæontology and Geographical Distribution.

A further example of the greater importance now attached to palæontology is given by Mr. Lydekker's volume on the "Geographical Distribution of Mammals," on the issue of which we congratulate the editor of the Cambridge Geographical Textbooks. Mr. Lydekker's work, reviewed on p. 392, is unique among manuals on distribution in the attention paid to fossil forms. The works of Schmarda (1853), Sclater (1858), Huxley (1868), and Wallace (1876) established zoological provinces on the evidence of living animals alone. Neglect of palæontology was necessary when these authors wrote, since the available evidence was so imperfect. The methods they were therefore forced to employ were as little likely to yield final results, as an attempt to deduce the original distribution of human races from that of the present day without any reference to the historical records of changes and migrations. It is not surprising that Mr. Lydekker's broader range of view renders necessary alterations in the classification of the zoological regions. Mr. Lydekker finds the time-honoured six regions of Mr. Sclater inadequate, and prefers ten regions divided among three realms, which are those suggested by Dr. Blanford in 1890. The ten regions are prepared mainly on the evidence of mammals, except in the case of the Hawaiian, which in the absence of a mammalian fauna depends on birds. The striking differences between arrangements based on different classes of animals themselves illustrate the necessity for the consideration of palæontology; for the differences are due, at least in part, to the varying distribution of land and water in past ages. That Mr. Lydekker's divisions do not suit all classes of animals detracts from their convenience but not from their truth. It may be objected that palæontological evidence cannot be relied on owing to the imperfection of the geological record. But after the discoveries among the mammalian faunas of Patagonia and the Argentine Republic, of the Western States of America, of India, of Australia, of the Mediterranean islands, not to mention the many localities on the mainland of Europe, this objection may be regarded as equal in value to the cry for missing links. Mr. Lydekker's book shows that systems founded on neontological evidence only have had their day.

International Congresses.

It has been decided by the British Association that all fellows and members of the American Association, meeting next year at

Detroit, be admitted as members of the British Association during its Toronto meeting, on the same terms as old annual members. *Science* takes the opportunity to suggest that there should be established an International Congress for the Advancement of Science. "The co-operation between the British, French, and American Associations, the successful international congresses in the separate sciences and for scientific bibliography, the establishment of journals international in circulation, in contributions, and even in editorship, are steps in the forward movement leading directly to a world's congress of men of science." Our readers will remember a little note that we published on International Congresses a short time ago, and they will not expect us to support this proposal very warmly. The great fault of these gatherings is the want of organisation, and the more international the gathering, the worse, as a rule, is the organisation. We agree that most of the questions mentioned by our contemporary—"bibliography, nomenclature, the definition of units, libraries and museums, explorations, the teaching of science"—can only be settled by international co-operation. But they should be discussed, not by some general congress with a high-sounding title, but by special international committees appointed *ad unumquidque*.

The Encouragement of Zoological Research.

The International Congress of Zoologists in 1898 will be held at Cambridge at the same time as the congress of Physiologists. A committee, with Professor Alfred Newton in the chair, will arrange the details. Two prizes will be awarded on this occasion, the first, of the Czar Alexander III. for research on the ruminants of Central Asia, zoologically and geographically considered; the second, the prize of the Czar Nicholas II. for an anatomical and zoological monograph on some group of marine invertebrates. Manuscripts should be sent in to the president of the permanent Committee, 7 Rue des Grands-Augustins, Paris, before May 1st. 1898. The *Revue Scientifique* hopes the second subject may be altered in order not to promote the continual publication of monographs, and remarks "Il n'y a pas que les faits; il y a encore et surtout les idées, et les zoologistes contemporains semblent l'oublier souvent." We cannot say that we altogether agree with our estimable contemporary; for in the first place we do not see why a monograph on marine invertebrates should necessarily be destitute of ideas; in the second place, highly as we value ideas, we still maintain that they must be checked by reference to facts, and we agree with our contributor, Mr. F. G. Parsons, that the more facts we have at our disposal, the surer will be our conclusions. This, as our last number sufficiently showed, is what geologists and palæontologists are feeling, and we are glad to find, as the papers by Drs. Parsons and Keith instance, that many pure anatomists share the same view.

Jamaica as a Tropical Marine Biological Station.

In America, at any rate, they appreciate the value of extended acquaintance with facts, and for some years Professor W. K. Brooks has realised the importance to his students of taking an extra course of laboratory work at some more tropical centre. For this object Professor Brooks has given the preference to Jamaica on account of the more typical and varied conditions of both its marine and terrestial life. According to his experience, the Bahamas may be superior for a study of the fascinating life of the coral-reef, but, for the requirements of a more general training, Jamaica is perhaps better adapted. In 1891, the first party of students, with Professor Brooks at their head, made a three months' stay at Port Henderson, close to Kingston; in 1893 a second party under Dr. Bigelow did the same; and only recently a third party, consisting of Messrs. Conant, Clark, and Sudler, accompanied by Professor Brooks, have spent three months at the same place. The visit of these students is not entirely confined to laboratory work, but exploration and collection from the more important places in the island has been systematically carried out. At the invitation of the Board of Governors of the Institute of Jamaica, a special meeting of the members of the institute was held in the lecture room, and the members of the Johns Hopkins University Marine Laboratory then stationed at Port Henderson gave an account of the work performed by them on the fauna of Jamaica. Mr. Conant discussed the chætognaths, or arrow worms; Mr. Clark, the holothurians, or sea cucumbers; and Mr. Sudler, the crustacean genus, *Lucifer*. The Institute of Jamaica has not been slow in recognising the value to the island of the work carried out by the Johns Hopkins students, and has placed itself in close communication with the university, and, in return for the assistance afforded, the institute obtains the valuable help of Professor Brooks and his students in naming specimens in the museum, and in receiving valuable duplicates of the treasures collected by the workers. The governors of the institute also realise that it would be of value to zoology generally if some scheme could be devised for holding vacation biological sessions at Kingston; anyone desirous of obtaining further information may apply to Mr. J. E. Duerden, the curator. At the close of the special meeting referred to above, Mr. Duerden commented on the extraordinarily complete course of instruction received by the Johns Hopkins students, and pointed out that after four years' general course at the university, the students usually gave from three to five years to research work, from which he hoped that Jamaica would receive a considerable and lasting benefit.

Teaching Physiography.

We are are glad to observe that the Science and Art Department has taken the subject "Physiography" in hand, and if it has

not more fully justified the title of that hodge-podge of elementary science, it has made a more rational use of it by substituting experiments—or, at least, the suggestion of experiments—for what was originally a lecture syllabus only. It is perfectly true that lecturers of any standing have for years used apparatus in illustration of their remarks, but the syllabus as now drafted cannot fail to re-model the whole subject. Instead of a smattering of geology and astronomy with a little physics and chemistry thrown in, the students will now have placed before them enough of each of these sciences to whet their appetites, and to help them in making up their minds as to which branch they will in future pursue as a separate subject. That part of the new syllabus relating to physics (or so much of it as is intended to be taught in physiography classes) has been drawn up with especial care; but to our thinking too much astronomy is still apparent, whilst biology, in its relations to the distribution of animals and plants, is hardly insisted on at all. How different the subject as now drawn up by the Science and Art Department is from that originated by Huxley, must be very evident to those who have followed the fortunes of "physiography" from its commencement.

THE HINGE OF BIVALVE MOLLUSCS.

ON page 153 of volume viii. we referred to the researches of Dr. Felix Bernard upon the hinge of Pelecypoda. A further instalment of his results has appeared (*Bull. Soc. Géol. France*, 3e ser., t. xxiv., pp. 54–82), and gives an account of the development of the hinge in the Taxodont group of that class, *i.e.*, those with a great number of teeth in a row, such as *Arca* and *Nucula*.

Dr. Bernard points out, by way of preface, that the prodissoconch stage is so similar in all the groups as to lead naturally to the conclusion that it recalls a non-differentiated ancestral form; and he considers that the completed prodissoconch corresponds to a period of rest in the growth of the animal and of its shell, during which the internal organs arrive at perfection and the various cells specialise. This completed, growth recommences brusquely, but always least actively in the region of the hinge.

In the Taxodonts, as in the Heterodonts and Desmodonts, Dr. Bernard finds that the ligament originates in an internal central pit. Along the upper margin of the hinge-line, however, there appears a row of small quadrangular crenulations, which in every respect act as do the teeth of the adult shell: with these last, however, they have nothing to do. These prodissoconchal teeth the author has, since his previous paper appeared, found in a few Heterodonts. The true teeth of the adult shell arise on the hinge-plate, on either side of the ligament, by the formation of shelly ridges more or less parallel to the dorsal shell margin, much as they do in the Heterodonts, but arching over afterwards as growth proceeds. Both sets of teeth are present in

certain stages, except in the oyster, in which the true teeth never develop.

From the point of view of the morphology of the hinge the Taxodonts form a very natural and homogeneous group.

The author's general conclusions are held over till his studies of all the Pelecypod groups shall have been completed.

A Big Fungus.

The visitor attracted to the Botanical Department of the British Museum (Natural History) by the various additions and alterations to which we have recently called attention, will be faced on entering the gallery by a striking model of a huge specimen of the fungus *Hydnum erinaceus*, represented in the situation where it was found growing. It does not bear much resemblance to the familiar mushroom; nevertheless, the Hydneæ belong to the same group of fungi, namely, the Hymenomycetes; but whereas in the mushroom and its allies the spore-bearing layer (hymenium) is borne on gills on the under surface of the fungus, in *Hydnum* it covers projecting processes or teeth, which are well shown in this exhibit. The specimen, of which this is a model, was presented to the museum by the Hon. Mabel de Grey. It was found in the New Forest in the hollow trunk of an old beech tree, in which sheltered position it had grown to quite extraordinary dimensions, weighing 22 lb. 6 oz., though always retaining the long teeth and the characteristic heart shape of *H. erinaceus*. The exhibit reproduces very carefully the habitat and appearance of the plant.

Sexual Reproduction in Fungi.

Owing to the questionable fate of the numerous nuclei which are present in the sexual organs of the *Phycomycetes*, the exact nature of the processes of fertilisation in this group of Fungi is of the greatest interest. Our knowledge on this subject, however, has been in a very unsatisfactory condition, due to the contradictory results obtained by various observers. Mr. Wager has just worked out this point very fully and satisfactorily in *Cystopus candidus*. ("On the structure and reproduction of *Cystopus candidus*, Lév.," *Ann. of Bot.*, Sept., 1896.) The result of his investigations is somewhat as follows. The oogonia are formed by the passage of protoplasm with nuclei into expansions of hyphæ; when a certain quantity has passed, the oogonia become cut off by a transverse wall, and the nuclei can be distinctly made out. They have exactly the structure of those of higher plants, and consist of a nuclear membrane and network, and a nucleolus; the average number is about ninety.

The structure of the antheridia is very similar; they contain a small quantity of protoplasm with from six to twelve nuclei. The antheridia become closely pressed against the oogonia, and the latter then go through the process of maturation. Their protoplasm *with all*

the nuclei contracts towards the centre, forming there a spherical mass. This central mass then becomes differentiated into an external very dense layer (periplasm) and a central vacuolate mass (gonoplasm). The nuclei at the same time undergo division, and their number becomes doubled; the division is the typical indirect division of higher plants. They then become almost completely restricted to the periplasm, and there appears in the central part of the gonoplasm a deeply staining granular mass, in which one of the nuclei becomes embedded. This proves to be the nucleus that fuses with the one brought by the fertilizing tube.

In the antheridium also the nuclei divide, and one of the daughter nuclei passes with a small quantity of protoplasm into the fertilizing tube, which is protruded from the antheridium. This tubes bores its way into the oogonium and through the periplasm and gonoplasm, till it comes in contact with the central mass of dense protoplasm. The antheridial nucleus is then expelled and is found in close contact with the nucleus of the oosphere. At this stage a delicate membrane becomes visible round the oosphere, and the two nuclei shortly fuse together and fertilisation is complete.

The cell-wall of the oospore is formed from the mass of the periplasm, and the nuclei, which were embedded in it, degenerate. Thus, of the numerous nuclei present in the oogonium and antheridium, only one from each organ takes an active part in fertilisation.

BOTANICAL CRUMBS.

AT a recent meeting of the Manchester Philosophical Society a paper by the late Mr. Thomas Hick was read, in which the affinities of *Rachiopteris*, a fossil plant of doubtful position, are discussed. The name was given by Williamson to some plant remains from the lower Coal Measures of Halifax, which he thought might be true ferns. From an examination of the anatomy of this fossil, which has a dichotomously branching stele, Mr. Hick concludes that *Rachiopteris* cannot possibly be a root, but is probably a stem or leaf-structure of a plant having more affinity with ferns than with lycopods.

At the same meeting Mr. J. H. Ashworth described the structure and contents of the tubers of an hepatic, *Anthoceros tuberosus*, from the banks of the Swan River, West Australia. These tubers, which are attached to the lower surface of the thallus by a stalk, are well protected by three or four layers of corky cells on the outside, while the interior is filled with closely packed cells containing granules and oil-drops. The granules give all the reactions for proteids, and seem to be aleurone grains comparable to those forming the proteid reserve material of seeds. Similar tubers were also found enclosed within the substance of the thallus. Such well-protected resting organs, or gemmæ, are eminently adapted to preserve the existence of a species in such a climate as that of West Australia, where periods of severe drought have to be provided against.

I.

The Determination of Fossils.

THE Note in our last number headed "Pavingstone Palæontology" has brought us, as we expected, communications from various people who felt that our remarks applied to them. In some cases they were not far out; but as to other cases we thought it clear that we were not criticising all published lists of fossils, and certainly not those that were compiled with the properly acknowledged aid of specialists. The difficulty of the geologists is well put by the letter from a "Stratigraphical Geologist" printed in the present number; it is the difficulty of finding specialists. Those who live in the great centres of intellectual activity are apt to make light of this difficulty, but it is one that we fully recognise. Specialists in palæontology are not numerous, their names and addresses and the subjects with which they are prepared to deal are not always so well known as are those of Cabinet Ministers, finally they are not always anxious to work over carpet-bags full of imperfectly preserved fossils, left with them by too enthusiastic friends. On the other hand, the real specialist on any subject is, or ought to be, glad to examine specimens belonging to the particular group that he studies, especially when these have been collected with due attention to horizon and locality. We have therefore thought that the publication of a list of those studying particular groups may be of value, first, as showing stratigraphical geologists where they can obtain assistance, secondly, as putting specialists in communication with those who can forward their own studies by material and by information, and lastly, as indicating what groups of fossils are still in need of students. The list that the kindness of the palæontologists mentioned in it enables us to publish may help in these directions; and with regard to the last point, we would urge each stratigraphical geologist, provided he has had sufficient zoological training, to make himself a specialist in some small branch that is not represented here; thus the list will gradually become more complete, and by the organisation of labour, workers will be able to render mutual aid, while British geology and palæontology will advance with firmer foot.

Concerning this list some remarks are necessary. No name in it is published without the express sanction of its owner. But this

sanction has been given upon definite conditions to which we must direct the attention of those desiring a specialist's assistance. Every specimen sent to a specialist must be labelled with definite locality and horizon. The sender must give satisfactory assurance that he desires the information for purposes of publication, and not merely for the sake of having his collection named. Full acknowledgment of the assistance rendered by the specialist must be published. The specialist reserves the right of himself publishing, in any way that seems to him best, any new species or other points of biological interest afforded by the material submitted to him. It is also important to notice that many of these specialists are connected with public institutions or have their time otherwise largely occupied; in some cases they will justly demand to receive some further benefit, as by the presentation of selected specimens to their institution. In no case can NATURAL SCIENCE be responsible for the sending of collections, for the determination of specimens, or for the publication of results; but the sender and the specialist between them must make their own arrangements and their own bargain.

We may also point out that this list does not profess to be a complete list of British palæontologists. Some we may have overlooked and omitted to ask; some whom we have asked have not yet replied; others have refused their assistance; while others, though they profess a readiness to help all *bonâ fide* workers (which is more than we asked them to do), are not so ready to inform the workers of their good intentions. However, we hope at no distant date to publish a supplement to this list, and we hope also that our list will be copied, with or without additions, by any of our contemporaries that share our desire of helping scientific workers.

LIST OF SPECIALISTS.

VERTEBRATA—		
Mammals	From any horizon	R. Lydekker.
„	British Pleistocene	E. T. Newton.
„ Rodentia	From any horizon	C. Forsyth Major.
Birds	„	C. W. Andrews.
Reptiles, Amphibia	„	R. Lydekker. / A. Smith Woodward.
Fish	„	„ „
„	Palæozoic	R. H. Traquair.
„	Coal-Measure	H. Bolton.
ARTHROPODS—		
Arachnids	From any horizon	R. I. Pocock.
Myriopods	„	„ „
MOLLUSCS	British Non-Marine, Tertiary to Recent	B. B. Woodward.
Cephalopods		
„ Esp. Nautiloidea	From any horizon	A. H. Foord.
„ Ammonoidea[1]	From Lias and Lower Oolite	S. S. Buckman.
Gastropods	Jurassic	E. Wilson.
„	Palæozoic *Murchisonia*, *Ælisina*, and allied forms	M. Jane Donald.
„	British Eocene and Oligocene[2]	G. F. Harris.
Pelecypods	„	„
„	Cretaceous	H. Woods.
„	Coal-Measure	H. Bolton.
BRYOZOA	Jurassic	J. W. Gregory.
„	Precarboniferous[2]	„
BRACHIOPODS	Mesozoic	J. F. Walker.
ECHINODERMS—		
Echinoids	Palæozoic	J. W. Gregory.
Asteroids, Ophiuroids, Crinoids, Cystids, Blastoids	From any horizon	„
	„	F. A. Bather.
FORAMINIFERA	„	F. Chapman. / C. D. Sherborn.
PLANTS	Mesozoic	A. C. Seward.
„	Palæozoic	R. Kidston.
Monocotyledons (Palms, etc.)	From any horizon	A. B. Rendle.
Algæ	„	G. Murray.

The addresses of the above are mostly to be found in the lists of Members of the Geological Society and Geologists' Association, as well as in other lists and address-books.

[1] Suture-line to be marked in Indian Ink.

[2] If allowed to retain duplicates.

[3] If allowed to select specimens for British Museum.

II.

Zoology since Darwin.[1]

Part III.

NOW that we have seen what new paths zoology has taken since the time of Darwin, let us consider how its old, once exclusive, tasks, the description of the present state of animal forms, and the observation of their vital activities, have grown into systematics and biology in the narrower sense.

The theory of natural selection gave a new and mighty impulse to biology after it had been for a long time neglected. It entered on a flourishing period, which can only be compared to the brilliant age of biological discoveries made by Réaumur, Roesel, De Geer, Bonnet, Schäffer, and others in the eighteenth century. After Darwin's time how important became the relations of animals among themselves and to the plants, the influence of climate and food, and of light and warmth in the struggle for existence, in the phenomena of natural selection! The whole world afforded material, and books appeared, like H. W. Bates' "The Naturalist on the Amazon River," and A. R. Wallace's "The Malay Archipelago," real models of biological study. To these were added a whole host of naturalists, chiefly English and German, who everywhere found in the biology of animals and plants fresh proofs to support the Darwinian theory, though, at the same time, they pointed out puzzling phenomena, the solution of which, even to-day, defies the intelligence of the naturalist. Yet in this, as in other subjects, we know very well that neither our knowledge, nor our efforts, nor our means of arriving at the truth are as yet complete.

Formerly, geographical distribution was always reckoned among biological facts. This was probably only due to the fact that at that time people usually sought to explain the problem of the cause of faunistic differences by a reference to life-conditions, and as this seldom was satisfactory, animal geography was in reality a collection

[1] Lecture delivered by Professor Ludwig von Graff on his installation as Rector Magnificus of the K. K. Karl Franzens University in Graz, November 4, 1895. The profits from the sale of the original go to the Freitisch-Stiftung of the University. (*Continued from p.* 315.)

of lists, the perusal of which gave the zoologist no more food for thought than did the sight of a menagerie.

In this respect the new teaching of the theory of descent made a revolution, by first rendering possible a scientific treatment of zoogeographical facts. The faunistic character of a region is decided by its geographical age, and also by the phylogenetic stage of evolution of the animal world at the time of its settlement, and by its changing geographical relations to other faunal districts, during the different phases of the earth's history. It follows therefrom that it is not so much phenomena due to adaptation, but rather crises in the history of the stock, which decide the typical character of a fauna. Thus, zoogeography becomes an important branch of phylogeny.[2] A. R. Wallace, in his celebrated work, "The Geographical Distribution of Animals," laid stress on this point, and thereby became the teacher of modern zoogeography. A necessary condition, however, to the further progress of this science is the utmost exactness in the wearisome details of systematic descriptions of species.

Descriptive systematics have benefited from the new method, indirectly much more than directly, because the new teaching awakened general interest in zoology and botany, and thus directed more working energy into those channels than there ever was before. Moreover, it is easy to prove that the colossal addition to our list of animal forms—about 50,000 in 1832, to-day about 150,000—is due no less to the increase of means of communication and to the evolution of geography. It was not till the latter, from being the handmaid of history, passed into an independent science, and oceanographic questions came to the fore, that those big expeditions were undertaken, which form another characteristic of this period of zoology. One is involuntarily reminded of the time of Piso, Marcgravius, and Bontius, who, at the beginning of the seventeenth century, showed to wondering mankind the pictures of the Dronte and the Homo silvestris, from "The Two Indies," when one realizes that the "Challenger" Expedition of 1873–76 (concerned chiefly only with marine forms), brought back nearly 8,000 new species of animals. The description of these resulted in hundreds of new genera, families, and orders, and occupied sixty zoologists of all civilized countries twenty years, appearing finally in thirty-two quarto volumes, with

[2] Genealogical relations are brought especially into prominence in geographical distribution in those cases where there exists a proportion between the geographical separation and the amount of morphological difference. This important law was first formulated by H. Spitzer in his excellent "Beiträgen zur Descendenz Theorie" (Leipzig, 1886), and proved by him (pp. 259 et seq.) for the orders of apes and ostrich-like birds. This proportion should also be demonstrable in many other groups of animals. It may here be pointed out that one of the most decided opponents of the Theory of Descent with Modification (A. Wigand), made his agreement with the latter dependent upon the possibility of such a relation between geographical separations and morphological differences being proved. (A. Wigand, "Der Darwinismus und die Naturforschung Newton's und Cuvier's," Braunschweig, 1874-77.)

2,629 plates.[3] In many groups the results of this one expedition have increased the number of known species four- or five-fold.

The first result of this increase in the number of described forms was to render urgent a broader basis for, as well as a more definite content of, species description, in opposition to the Linnæan methods of systematic description, hitherto adopted, whose only scope was the separation of a new species from those *already known*, by distinguishing characteristics. One still had to try and grasp the "Specific" of an organism by which it could be distinguished from forms *yet to be discovered*. This demand, formulated even before Darwin's time by conscientious systematists, is of course difficult, and only to be complied with by one possessing an artistic sense of form. Furthermore, the Darwinians themselves frequently delighted in a wilful neglect of systematics, which arose partly out of contempt for the "hair-and-brush systematics" practised in museums (which was chiefly antagonistic to the new teaching), partly from an exaggerated conception of the variability of species—conceptions that produced the most eccentric phenomena in systematic work.

Happily, this fermentation period is over; we are learning to value again exact systematic description, as it has remained chiefly in the too-long neglected science of entomology. We only need to enlarge the methods of the latter by a more extended regard for comparative anatomy and evolution, in order to express ever more and more systematically the natural relationships of organisms. For one thing is sure, that the minute description, customary in entomology, of diagnostically important outward characters has done much less harm than the neglect with which these external characters were treated by the "scientific" zoology of the last decades. To this kind of zoology are due the facts that in modern monographs the systematic parts are often so superficially treated that they are useless to a conscientious zoogeographer, and that German zoology has been not unjustly reproached for bringing forth excellent theorists, and splendid comparative anatomists and embryologists, but no zoologists. As though, forsooth, knowledge of forms were not the foundation of all zoology, and as though one could obtain a living representation of the phenomena of variation without having practised the eye by exact systematic study in at least one group! Darwin himself gave a pattern of exact systematic description in the monograph on the cirripedes[4] at a time when the selection theory was already perfectly formulated in his mind. What student of the

[3] "Report on the scientific results of the voyage of H.M.S. 'Challenger,' during the years 1872–76, under the command of Captain Sir George S. Nares and the late Captain Frank Tourle Thomson. Prepared under the superintendence of the late Sir C. Wyville Thomson, and now of John Murray." 50 Vols., in quarto. London, 1880–95. See also "Challenger" number of NATURAL SCIENCE, July, 1895.

[4] Charles Darwin, "A Monograph of the sub-class Cirripedia, with figures of all the species." 2 Vols., London, 1851–54.

animal system is ignorant of the deep correlation existing between seemingly immaterial outward characters and important points in internal organisation, so that artificial systems built on the former alone nevertheless result in a grouping quite corresponding to natural relationships?

The necessity of a change in this direction was, of course, recognised. Soon after its foundation in 1890, the German Zoological Society resolved upon the compilation of a gigantic systematic work, comprising all hitherto known species of animals,[5] and caused a new edition to be printed of Linnæus' "Systema Naturæ."[6] These are eloquent signs of the general need of deeper systematic work.

Yet it must not be overlooked that even the best descriptions of species to-day are pure abstractions, which comprise in one united individually coloured picture the results of research on a more or less large number of individuals. Through such syntheses as these one arrives at ideal species to which no one individual ever quite corresponds, and which do indeed satisfy the first-felt requirement, viz., comprehensibility, but which can never supply the material that we need for the scientific extension of the theory of descent. For that one would really want exact descriptions (divested as much as possible of the subjective) of countless single objects. It would be necessary to portray exactly the united examples of many generations with all individual traits, especially in those species to which great variability is ascribed. If the crossing of individuals could be carried on under varying external conditions, it would be possible to distinguish between constantly-inherited and variable characters. In the domain of botany an attempt of this sort has been made, namely, in Nägeli's "Researches on Hieraciæ,"[7] in which this quick-witted thinker insists upon the importance of a sharp division between uniformity and constancy on the one hand, and between multiformity and variability on the other. In the animal world such experiments as these are very much more difficult, but certainly not impossible, and yet hardly any have been undertaken.[8] In this province there lies open to the systematists of the future a field of work as large as it is fertile.

Systematics, therefore, which, in the descriptive period before

[5] The publication of this is happily ensured already, and competent workers have been secured for most of the animal groups. It will appear under the title, "Das Tierreich: Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen," published by R. Friedländer und Sohn, Berlin. (See NATURAL SCIENCE, vol. viii., p. 305, May, 1896.)

[6] Caroli Linnaei, "Systema Naturæ, regnum animale.' Editio decima, 1758. Cura societatis zoologicæ germanicæ iterum edita. Berolini, 1894.

[7] C. v. Nägeli, "Mechanisch-physiologische Theorie der Abstammungslehre," pp. 239 et seq. Munich and Leipzig, 1894.

[8] Even for the most elementary of the problems here named, viz., the one concerning the degree of variability of animal species in nature, very little material has hitherto been collected. Cf. A. R. Wallace, "Darwinism."

Darwin, was merely an insufficient inventory of short differentiating characteristics arranged with a view to comprehensibility, after his time developed into a pedigree expressing true blood-relationship, and will, in the next period of our science, be unable to dispense entirely with experimental research.

Looking back, we see how in all the chief branches of zoological science the theory of descent newly formulated by Darwin has become the motive of a thoroughness in research, not found in any earlier period. It is characterised by the preponderance of the morphological interest, which has led to such a one-sided neglect of physiology, that to-day, when the development of morphology forces the formulation of questions whose answers experiment alone can supply, neither the methods of work nor the worker himself are at hand to solve them.

Morphology, seeking for explanations, threatened to become a victim of a new edition of the Schelling-Oken natural philosophy, had she not in healthy self-knowledge already mapped out the new path, which led the way out of danger. Still governed by the slowly dying exclusively morphological standpoint, zoology begins to recognise as her new aim, the "doctrine of the causes of organic formation," and Roux has even founded a journal devoted only to this subject.[9] But this title does not comprehend the whole domain now to be striven for, which can perhaps be better called, "Comparative Physiology," or "Biomechanics."[10] Darwinism has steeped the old descriptive zoology with the philosophical spirit and made out of it a historical doctrine—it remains for the coming generation to transform it into a *causal* science resting on a basis of Experiment.

LUDWIG VON GRAFF.

[9] "Archiv für Entwickelungsmechanik," edited by W. Roux, Leipzig, 1894, &c.

[10] Y. Delage, "Une Science Nouvelle: la Biomécanique" (*Revue générale des sciences pures et appliquées.* 6e. année, No. 10. Paris, 1895).

III.

A Plea for Details in Comparative Anatomy.

IT is only of late years that human anatomists have realised how difficult it is to describe definitely the arrangement of any single part of the body. In former times the text-books were compiled from the dissection of one or two bodies, and the statements made were accepted, without question, as the normal condition of affairs. If a too enquiring student complained that the body he was dissecting differed in many points from the text-book description, he was told that he was unfortunate in coming across so abnormal a subject; but it seems to have seldom entered his, or his teacher's, head that there was almost as much chance of the body being correct as of the text-book. The next phase in the attitude of anatomists, one that followed the greater opportunities for studying the human body, was careful collection of all the arrangements of parts that differed from the text-book descriptions, and the conscientious recording of them as abnormalities; but the proportion in which these occurred was seldom worked out, nor apparently was it doubted for a moment that they really were abnormalities. Recently this reliance on the standard text-books, as though they were inspired, has given way to a more healthy scepticism, and anatomists are now doing their best to find out how great the variation of different parts really is, and to fix the normal arrangement only when this has been discovered from observation of a large number of bodies. This is the work which is being done in England by the Anatomical Society, and in Germany by a great many independent workers, who realise the necessity of having a large number of absolute facts before attempting to generalise or make deductions, before even saying "this we must at present regard as the normal." The lesson taught us by recent work in human anatomy is, that it is wrong to make any dogmatic statements as to the arrangement of any part of man's body until a large number of specimens has been examined and recorded. Probably the same lesson holds good for the other animals; but at present we are unable to speak definitely, and it is with the object of asking for more facts that I am writing this little paper.

It has probably happened to many of the younger anatomists, as it has happened to me, to have gone carefully through the dissection of some animal, and then to have been told that the subject had been

thoroughly worked out by someone else. The information is usually given in a tone that leaves the impression on the student's mind that the anatomy of the animal in question is the private property of the first describer, and that to publish the same thing again would be a sort of infringement on his rights. From our present point of view, however, the record of every dissection that has been made would be most valuable, and there can be little doubt that an immense amount of valuable time and work has been lost to us through the worker's mistaken impression that, because it had all been done before, he was not justified in burdening literature with a repetition. It may be contended that, if every worker recorded all his observations, the world itself would not contain the books which would be made, and that a huge mass of useless lumber would more than counterbalance the value of a few useful facts. This I do not think would be the case; there are a great number of scientific periodicals, journals, and proceedings which could easily afford to enlarge their space if more material were forthcoming. Moreover, it is so easy nowadays to hear of and refer to the work of others, that less and less space will in future be needed for statements of work done. For instance, suppose an anatomist wishes, for his own instruction, to work through the anatomy of the cat, he would be more than justified in sending, on the completion of his investigation, a note to any zoological publication saying what he had done, what he had looked for, and that in every particular, if it so happened, his own observations tallied with those of Mivart in his classical work on the cat. If this were done we should soon have a valuable set of statistics, and should begin to appreciate which parts of the cat's body were most stable and which most variable; and it would be possible to contrast these parts with those of man, and eventually of other mammals.

In referring to the descriptions of work done by many observers, one is often led to regret that they have evidently compressed it into the smallest limits, and have left out all mention of points which to them appeared trivial, forgetting that some of these apparently trivial points might turn out to be important characters of an order or family, and that, by neglecting to record them, they might possibly be leaving out the most important point in the whole observation. How often one finds, in referring to papers on myology, two or three important muscles left out, presumably because, as they were quite normal, the recorder did not think it needful to encumber his communication with facts which were the same as those mentioned by others before. These omissions are often very serious to the worker studying the myology of a group: he cannot take it for granted that because the muscles in question are not mentioned they are therefore the same as those recorded by others; he cannot even feel sure that they have been looked for. Thus good work is irretrievably lost. I feel convinced that the saying "if a thing is worth doing at all it is worth doing well" applies to the work of recounting scientific observations

quite as much as to any other action of life. A good proof of the correctness of the views here pleaded for can be gained by contrasting the early and late papers of many of our well known writers; their earlier works often sum up the anatomy of an animal in a page or two, while later on they will frequently devote pages to the details of one small portion of a creature's body, and will not hesitate to add columns of figures and minute measurements that seem ludicrous to anyone glancing over the paper, but may be welcome enough to the worker who is trying to harmonise the account of one person with that of another.

It may be that this appeal of mine for more descriptions and details will be open to misconstruction, and that I may appear to reproach the Publication Committees of our various societies with suppressing, or at least discouraging, a mass of technical detail. Nothing is further from my intention, and a glance at the *Proceedings* and *Transactions* of these societies would make any such charge appear ridiculous. But I cannot help feeling convinced that a good deal of work is done yearly by the younger anatomists of which no record is kept, partly because of the impression that, since it has been done before, it will not be welcome, and partly because they do not consider themselves well enough up in the literature of the subject to make a complete paper. Neither of these objections should allow sound work to be lost to science; comparisons and generalisations can be worked up from time to time as material accumulates, while our excellent *Zoological Record* and various indices will prevent papers being lost sight of, no matter where they may have been published. I think that every anatomist who has worked at mammals of late years will agree with me that a description founded on one animal is of very little use, and that if we want to know how great or how small a part variation plays in different animals, it will be necessary for every observer to record all the results of his work.

St. Thomas's Hospital. F. G. Parsons.

IV.

An Introduction to the Study of Anthropoid Apes.—IV. The Gibbon.

THE greater part of the literature on the gibbon is devoted to a consideration of its specific and generic characters. Our knowledge of its anatomy is based upon a very small amount of material. Until five years ago, when Kohlbrügge published dissections of four specimens, our information was confined to incomplete descriptions of the anatomy of five animals. The paucity of research upon this animal, which, for many reasons, is the most interesting of the anthropoids, is not due to lack of material, for within a recent period there have been thirty-five specimens, belonging to various species, in the Zoological Gardens at London. After their arrival in Europe, they are soon at the disposal of the dissector, for unfortunately they do not live long in confinement, few of them more than a year. Of three gibbons that were in the Rotterdam gardens, two lived for about a month, the other died after a sojourn of eight days.

The Nervous System.—The brain of the gibbon is comparatively small and simple, resembling in its form and topography much more the brains of cynomorphous monkeys than those of the three great anthropoids. Recently it has received a great deal of attention. Kohlbrügge had at his disposal the brains of twelve specimens (eight of *Hylobates syndactylus*, two of *H. leuciscus*, one of *H. lar*, and one of *H. agilis*), but his observations refer mostly to weight and measurement, and only slightly to the convolutions and fissures. Waldeyer (326, 327) has given a very full account of the fissures and sulci of three brains (*H. syndactylus*, *H. leuciscus*, and *H. lar*), with accompanying figures. The figures which Bischoff (293) gives of the brain of *H. leuciscus* are extremely good. Deniker (17) has given a clear account, accompanied with figures, of the brain of a fœtus of about full time. Figures of the brain of *H. syndactylus* are given by Sandifort (271). Kükenthal and Ziehen describe the fissures of the brains of *H. hoolock*, *H. lar*, and *H. leucogenys*, Ziehen of *H. muelleri*, and other references to the surface anatomy of the brain will be found in papers by Broca (103), Hervé (48), and Eberstaller (298*a*). Flower (301) and Cunningham (118) have examined the relationship of the cerebrum to the cerebellum, and of these to the skull-wall. The brain-weight and ratio has been estimated by Keith (146). The nerves have received a con-

siderable amount of attention, those of the limbs from Hepburn (45), Kohlbrügge (313), and Ruge (316), while the two anatomists named last, Jhering (143), and Utschneider (209) have described the arrangement of the trunk plexuses. From the above list it will be noticed that there is a complete absence of any inquiry into the more minute anatomy of the nervous system.

The Muscular System.—Kohlbrügge (313) and Deniker (17) have given very complete descriptions of the muscles—in fact, the most complete accounts we have of the muscular system of any of the anthropoids. Bischoff (293) also investigated this system in detail, while Hepburn's (45) account refers to the muscles of the limbs only. The muscles of the face and of the trunk have been very exactly described and figured by Ruge (70, 190, 316). Other facts may be gleaned from the dissections of Sandifort (271) and Vrolik (210). There are a number of special papers, mostly dealing with muscles of the toes or fingers, by Bischoff (100), St. John Brooks (106, 107), Schulze (318), Testut (321*a*), and Keith (148, 311*a*).

The Joints and Ligaments.—The ligamentous structures have been described, but not very fully, by Deniker (17), Kohlbrügge (313), and Keith (250).

The Skull.—Most of the literature on the skull of the gibbon is of a general and unsatisfactory nature. No attempt has been made, upon a sufficiency of material, to determine either the specific or generic cranial characters. It is true that Giebel (305) and Anderson (291) pointed out certain features of the skull which they thought characteristic of certain species, but they had too few skulls at hand to draw conclusions with any degree of security. In a collection of gibbon skulls, the only one which is distinguished from the rest with facility is that of the Siamang *(H. syndactylus)*; all the others, with perhaps the exception of that of *H. agilis*, being recognisable from each other only by their labels. It is possible that an examination of a much larger collection than thirty-five skulls, which is the number I had for study, might lead to more positive conclusions, but as yet there is not material enough collected for such an investigation. Descriptions of the cranial characters may be found in Duvernoy (22), Bischoff (293), Fry (302), Schlegel (193), Huxley (49*b*), and in most text-books or general works on mammalian osteology. There are some papers dealing with special features, such as those of Albrecht (290) and Morselli (169) with the vermian fossa; of Gegenbaur (303) with the lachrymal bone; of Hamy (35) with the anterior nasal spine; of Regnault (182) with the sutures surrounding that bone; of Seydel (278) with the nasal cavities; of Keith (311*a*) with the temporal ridges; and of Waldeyer (211) with the posterior palatal spine.

The Skeleton.—Descriptions of the skeletal characters are given by Blainville (223), Duvernoy (22), Bischoff (293), Meyer (58), Mivart (61, 61*a*), Fry (302), Schlegel (193), and Vrolik (210). For observations on the bones of the hand and foot, one may consult Lucae (54),

Rosenberg (187*a*), Lazarus (153), Kohlbrügge (313), and Deniker (17); regarding the vertebral column, Cunningham (118) and Kohlbrügge (313); for the sacrum, Broca (104) and Paterson (179); as to the sternum and ribs, Ruge (316) and Keith (149).

The Teeth.—The general characters of the teeth have been described by Owen, Huxley, and Tomes, and more minutely by Topinard (82), Magitot (56, 57), and Giebel (240, 305); Kohlbrügge (313) and Duvernoy (22) have also made passing observations concerning them. Bateson (92) and Lessona (314) have dealt with the anomalies of the dental series. No one, with perhaps the exception of Giebel, has worked out in any detail the dental characters of the species; but, speaking from my own experience, only the teeth of *H. syndactylus* present features at all distinctive, but, as I had occasion to remark when dealing with the skull, the material to which I had access was too small to allow of a positive statement being made.

The Alimentary System.—The alimentary tract has been examined from end to end by Deniker (17) and Kohlbrügge (313). Smaller and more general communications have been made by Bennet (292), Bischoff (293), Flower (28), Hunter (310), Yarrel (329), and Keith (311*a*). All, with the exception of the two last-named, have given descriptions of the liver.

The Respiratory System.—Deniker (17) and Kohlbrügge (313) give full descriptions of this system. Only the Siamang possesses air-sacs prolonged from the ventricles of the larynx—*see* Sandifort (271), Bennet (292), and Kohlbrügge (313). The last-named and Eschricht (299) give full descriptions of the muscles of the larynx. Some details concerning this system may be obtained from the writings of Bischoff (293), Hunter (310), Sandifort (271), and Duvernoy (22). Ruge (189) has investigated the relationships of the pleural and pericardial cavities to the chest-wall.

The Circulatory System.—It is much to be regretted that only very incomplete descriptions of the arterial and venous systems have been published. Deniker's (17) is the best, but a good deal may be learned from the accounts of Bischoff (293), Kohlbrügge (313), and Hunter (310). Keith (147, 311) has pointed out the arrangement of the trunks of the aortic arch and abnormalities of the inferior vena cava. The dimensions of red blood-corpuscles are given by Gulliver (135), and the position of the heart by Ruge (189).

The Ductless Glands.—The thyroid, thymus, and spleen are described by Deniker (17), and Kohlbrügge (313). Keith (311*a*) observed that the spleen did not become enlarged even in gibbons inhabiting very malarious districts.

The Genito-Urinary System.—Harlan (307) described a specimen which, according to him, was one of those extreme mammalian rarities, a true hermaphrodite possessing both ovaries and testicles. No microscopic examination of these organs was made, the testicles having been taken away in the removal of the skin. The greater part

of his description of the genital organs agrees with the parts of a normal female. Both the male and female organs of the gibbon are somewhat peculiar, and no good description has yet been given of them. Bischoff (6, 293) and Deniker (17) give descriptions of the female; and Hunter (310) and Kohlbrügge (313) of both male and female organs. Harlan (307) observed regular menstruation in the female, but I have never observed a uterine discharge in animals shot in the jungle. Deniker (17) and Kohlbrügge (313) are the only writers that describe the urinary apparatus.

Psychology.—The gibbon is extremely difficult to get under observation in the jungle, owing to its timidity and wildness. Jungle notes refer only to its curious vocalisation and agile method of locomotion—*see* Theobald (314*a*), Blanford (294), Anderson (291), Tickell (323), Müller (272), and Mohnike (260). Observations of its habits in captivity have been made by Darwin (120), Bennet (292), Hermes (139*a*), Klein (312), and Schmidt (317).

Organs of Sense.—The arrangement of the touch-papillæ on the hands and feet has been described by Kollmann (150), and the organs of smell by Zuckerkandl (216).

External Characters.—The young of a great number, if not all species of gibbon, are born with hair of a fulvous or greyish tint, as are also the young of *Semnopitheci*, monkeys with which gibbons have structurally much in common. Between their third and fifth years, however, the fulvous or grey hair of the young gibbon is replaced by hair of a lighter colour—a dun, light or dark brown, or even black, although many individuals retain the hair of youth throughout life; so that in nearly all species of gibbon, the hair varies in different specimens from a light fulvous colour to black. A curious feature is the tendency of white hair to appear in a ring round the face and on the backs of the hands and feet. In *H. lar*, *H. pileatus*, and *H. agilis*, the white circumfacial ring is complete; in *H. leuciscus* and *H. muelleri* approximately complete; in *H. hoolock* it is represented only by a supraorbital band; and in *H. leucogenys* by an inframental stripe; while in *H. syndactylus* and *H. hainanus* it is quite absent. Good figures, showing well the external characters of *H. lar*, *H. hoolock*, and *H. leucogenys*, are given in the *Proceedings* of the Zoological Society of London (319, 319*a*). Hermes (139*a*) also gives a very good drawing of *H. lar*, and Bischoff (293) a photogravure of a young specimen of *H. leuciscus*. Bennet (292) and Horsfield (309) give descriptions of *H. syndactylus*, and most of the authors mentioned in the section dealing with classification have entered into this subject. The lines on the hands and feet have been depicted by Hepburn (46) and Alix (89); the tufted arrangement of the hair by Meijere (163); the external ear by Keith (311*a*). Measurements are given by Duvernoy (22), Lucae (54), Meyer (58), Hermes (139*a*), Tickell (323), Schmidt (317), Deniker (17), Cunningham (118), and Bischoff (293).

Distribution.—The areas occupied by the several species of

gibbons have not been defined with any degree of exactitude. The genus is restricted to Further India and the Malay Archipelago. The N.W. corner of this region, Assam and the region to the west of the Irawadi, reaching right up to the base of the Eastern Himalayas, is occupied by *H. hoolock*—Anderson (291), Blyth (295, 296), Blanford (294), and Theobald (314*a*). Next to it, occupying the greater part of Burmah and stretching southwards in the Malay Peninsula to an uncertain extent, is found *H. lar*—see the authorities quoted above, Tickell (323) and Cantor (297). It is the only species found in the Siamese province of Bangtaphan at the base of the Malay Peninsula, where the writer has shot and dissected six specimens. To the South of the Malay Peninsula, *H. agilis* is said to occur (Cantor). *H. leucogenys* occurs in Siam (Sclater, 319*a*) probably in the Menam valley; at any rate, the writer never saw it in either the provinces to the S.E. or to the S.W. of that country. In the S.W. provinces of Siam, and in Cambodia, occurs *H. pileatus*, Gray (306), but how far northwards it extends is not known; Swinhoe (320) reports the occurrence of a gibbon in China south of the Yangstze. *H. hainanus* (Thomas, 322) occurs in the island of Hainan. In Borneo two species occur, *H. muelleri* and *H. leuciscus*, Everett (300), Müller (272), Thomas (322*a*); in Java, *H. leuciscus*, and in Sumatra, *H. agilis* and *H. syndactylus*, which latter is also said to occur on the Malay Peninsula, but this is very doubtful. Besides the authorities quoted above, Geoffroy St. Hilaire (304), Rosenberg (267), Trouessart (324), Hartmann (43), and Mohnike (260) may be profitably consulted.

Classification.—There are three questions pertaining to the classification of gibbons that wait an answer. The first is: What is their position among the primates? The second: Should the Siamang (*H. syndactylus*) be separated from the genus *Hylobates*? And the third: How many species are there?

As to the position of the gibbons in the series of primates, there is a tendency at present, with which the writer is in sympathy, to remove the gibbons altogether from the company of the anthropoids and place them in a position intermediate between the great apes and the cynomorphous monkeys—Kohlbrügge (313), Ruge (316), and Vrolik (325). They are really cynomorphous monkeys adapted to locomotion in an upright posture. In the prevailing systems of classification, of which there are too many to make mention, the gibbon is arranged with the great anthropoids in a family commonly called Simiidæ or Anthropomorpha—Huxley (49*a*, 49*b*), Geoffroy St. Hilaire (304), Duvernoy (22), Flower and Lydekker (301*a*), and Broca (104*a*).

As to the position of the Siamang, Gray seems to me to have made a move in the right direction in placing it in a separate genus—*Siamanga*, including it with the common gibbon—*Hylobates*—in the tribe Hylobatina. Its skull, teeth, and laryngeal sacs are strongly

marked characters. Its nerves, arteries, muscles, brain, and viscera have, when only one animal is examined, nothing very peculiar about them; but when a larger number is examined, the sum of the Siamang's variations will be found to be strikingly different from those of ordinary gibbons.

There is still much doubt as to the number of species of gibbon. An extraordinary number of species has been named, and the list of synonyms is appalling—*see* Gray (134), Anderson (291), Blyth (295), Cantor (297), and Blanford (294). Some writers have been inclined to regard many, if not all, of the named species, excepting the Siamang, as mere varieties of one species—Gray (134), Kohlbrügge (313), and Schlegel (193). But there can be no doubt that all the species named in the paragraph on distribution are quite as well marked anatomically as the received species of *Semnopithecus* or *Cercopithecus*. Dahlbom (298) was in error in ascribing to species distinctive marks on the clavicles. It is true, as I have observed for myself in the dissection of six specimens of *H. lar* and three of *H. pileatus*, that it is impossible to draw an anatomical distinction between these species, but the series dissected is too small to allow of a final conclusion being drawn. Whether the species maintain their individuality through geographical segregation, or whether, if they were to meet and mix, sexual and social instincts would still maintain the present arrangement of species, are matters upon which no information has as yet been given. But the fact that certain of these species (*H. lar*, *H. pileatus*, and *H. hoolock*), if not all, have voices which can be distinguished, tends to show there is a physiological differentiation, and the colour markings are very constant. Gray (134) and Schlegel (193) give the most useful information regarding the number of species and the specific characters, and to bring these lists up to date I need but mention the more recent contributions on *H. hainanus*, Thomas (322), *H. leucogenys*, Sclater (319*a*), *H. entelloides*, Wunderlich (328), *H. leuciscus* (probably *lar*), Schmidt (317), and *H. concolor*, Everett (300).

REFERENCES.

[*For references numbered between* 1–88, *see pages* 32–37; *between* 88–216, *pages* 260–265; *between* 216–289, *pages* 323–326 *of this volume*.]

290. **Albrecht, P.**—"Sur la fossette vermienne du crâne des Mammifères." Bruxelles, 1884. Pamphlet, 25 pp.

291. **Anderson, John.**—"Anatomical and Zoological Researches." London, 1878.

292. **Bennett, G.**—"Wanderings in New South Wales, Batavia, Pedir Coast, Singapore, and China." London, 1834. Vol. ii., p. 142.

293. **Bischoff, Th. L. W.**—"Beiträge zur Anatomie des *Hylobates leuciscus* und zu einer vergleichenden Anatomie der Muskeln der Affen und des Menschen." *Abh. Math.-Phys. Cl. Ak. Wiss. München*, 1870. Bd. x., Abth. iii., pp. 199–297.

294. **Blanford, W. T.**—"The Fauna of British India, including Ceylon and Burma." London and Calcutta, 1888. Mammalia, part i., pp. 5–10.

295. **Blyth, E.**—"Notes on the Gibbons *hoolock* and *lar*." *Journ. Asiatic Soc. Bengal*, 1847. Vol. xvi., pp. 729–730.

296. ————.—"Catalogue of the Mammals and Birds of Burma." *Op. cit.*, 1875. Vol. xliv., pp. 1–4.

297. **Cantor, Th.**—"Catalogue of Mammalia inhabiting the Malayan Peninsula and Islands." *Op. cit.*, 1846. Vol. xv., p. 171.

298. **Dahlbom, A. G.**—"Studia Zoologica." Lund, 1856.

298*a*. **Eberstaller, O.**—"Zur oberflächen Anatomie der Grosshirnhemisphären." (Vorläufige Mittheilung). *Wiener Mediz. Blätter*, 1884. No. 16, 18, 19, 20, 21. (The writer has been unable to consult the periodical).

299. **Eschricht, D. F.**—Beschreibung einiger neuen Muskeln am Kehlkopfe eines langarmigen Affen. *Müller's Archiv. f. Anatomie*, 1834. pp. 218–221.

300. **Everett, A. H.**—"A nominal list of the Mammals inhabiting the Bornean group of Islands." *Proc. Zool. Soc. London*, 1893. pp. 492–495.

301. **Flower, W. H.**—"On the Brain of the Siamang." *Nat. Hist. Rev.*, 1863. Vol. iii., pp. 279–287.

301*a*. ———— and **Lydekker, R.**—"An Introduction to the Study of Mammals, Living and Extinct." London, 1891.

302. **Fry, E.**—"Osteology of *Hylobates agilis*." *Ann. Mag. Nat. Hist.*, 1846. Vol. xvii., pp. 484–491, and *Proc. Zool. Soc. London*, 1846. pp. 11–18.

303. **Gegenbaur, C.**—"Ueber die *pars facialis* des Lachrymale des Menschen." *Morph. Jahrb.*, 1882. Bd. vii., pp. 173–176.

304. **Geoffroy St. Hilaire.**—"Description des Mammifères nouveaux, etc." *Arch. Mus. Hist. Nat.*, 1er mémoire, t. ii., p. 532; 3me mémoire, t. v., p. 529.

305. **Giebel, C. G.**—"Hylobates syndactylus und leuciscus." *Zeitschr. Ges. Naturwiss.*, 1866. Bd. xxvii., p. 186; 1880, Bd. liii., pp. 193–196.

306. **Gray, J. E.**—"List of Mammalia collected in Camboja by M. Mouhot." *Proc. Zool. Soc. London*, 1861. p. 135.

307. **Harlan, R.**—"Description of a Species of Orang from Assam." (*H. Hoolock*). *Trans. Amer. Phil. Soc.*, 1834. N.S., vol. iv., pp. 52–59.

308. ————.—"Description of a hermaphrodite Orang-Outang from Borneo." *Journ. Acad. Nat. Sci. Philadelphia*, 1827. Vol. v., pp. 229–235.

309. **Horsfield, Th.**—"Zoological Researches in Java and the neighbouring Islands." London, 1824.

310. **Hunter, John.**—"Essays and Observations of . . ." Edited by Rich. Owen. London, 1861.

311. **Keith, A.**—"The frequent occurrence of a divided Inferior Vena Cava in the genus Hylobates." *Proc. Anat. Soc. Gt. Brit. and Ir.*, Nov., 1895.

311*a*. ————.—"Anatomical Notes on Malay Apes." *Journ. Straits Branch Roy. Asiatic Soc.*, June, 1891. pp. 77–89, 46 figs.

312. **Klein, A.**—"Die drei Gibbons im Zoologischen Garten bei Kopenhagen." *Zool. Gart.*, 1894. Bd. xxxv., p. 116.

313. **Kohlbrügge, J. H. F.**—"Versuch einer Anatomie des Genus Hylobates." Max Weber's *Zool. Ergebnisse einer Reise in Niederländ. Ost-Indien.*, Leiden, 1890. Bd. i., pp. 211–355. Bd. ii., pp. 139–206.

314. **Lessona, M.**—Anomalous dentition in a specimen of *Hylobates leuciscus*. *Atti Acc. Torino*, t. xii., pp. 326–328.

314*a*. **Mason, F.**—"Burmah, its people and natural productions." New edition, edited by W. Theobald, 1884.

315. **Ogilby, W.**—On a new species of Gibbon (*H. leucogenys*). *Proc. Zool. Soc. London*, 1840, p. 20; (*H. choromandus*), 1837, p. 68.

316. **Ruge, G.**—"Anatomische ueber den Rumpf der Hylobatiden." Max Weber's *Zool. Ergebnisse einer Reise in Niederländ. Ost-Indien.*, Leiden, 1890. Bd. i., pp. 366–460.

317. **Schmidt, Max.**—"Der grau Gibbon, *Hylobates leuciscus*." *Zool. Gart.*, 1886. Bd. xxvii., pp. 7–14.

318. **Schulze, F. E.**—"Die Sehnenverbindung in der Planta des Menschen und der Säugethiere." *Zeitschr. Wiss. Zool.*, 1867. Bd. xvii., pp. 1–22, 29 figs.

319. **Sclater, P. L.**—"On additions to the Menagerie of the Zoological Society of London." (Drawings of *H. hoolock* and *H. lar.*) *Proc. Zool. Soc. London*, 1870. p. 86, 2 pls.

319*a*. ————.—"On a white-cheeked Gibbon (*H. leucogenys*)." *Proc. Zool. Soc. London*, 1877, p. 679, pl. 70.; (*H. muelleri*), 1893, p. 435.

320. **Swinhoe, R.**—"On the Mammals of Hainan." *Proc. Zool. Soc. London*, 1870. p. 224.

321. ————.—"Catalogue of the Mammals of China, south of the Yangtsze, and of the Island of Formosa." *Tom. cit.*, p. 615.

321*a*. **Testut, L.**—"Le long fléchisseur propre du pouche chez l'homme et chez les Singes." *Bull. Soc. Zool. de France*, 1883. Vol. viii., pp. 104–184.

322. **Thomas, O.**—"Note on the Gibbon of the Island of Hainan." *Ann. Mag. Nat. Hist.*, 1892. Ser. 6, vol. ix., p. 145.

322*a*. ————.—"On some Mammals from Mt. Dulit, North Borneo." *Proc. Zool. Soc. London*, 1892. p. 227.

323. **Tickell, S. R.**—"On Hylobates lar." *Journ. Asiatic Soc. Bengal*, 1864. pp. 196–199.

324. **Trouessart, E. L.**—"Note sur les espèces de Gibbons et de Semnopithèques à la Birmanie." *Bull. Soc. Philom. Paris*, 1879. Ser. 7, t. iii., pp. 122–128.

325. **Vrolik, W.**—"Quadrumana." *Todd's Cyclopædia of Anatomy and Physiology*, London, 1847.

326. **Waldeyer, W.**—"Das Gibbon-Hirn." *Virchow's Festschrift*, Berlin, 1891. Bd. i., pp. 1–401.

327. ————.—"Sylvische Furche und 'Reil'sche Insel des Genus Hylobates." *SB. Math.-Phys. Cl. Ak. Wiss. Berlin*, 1891. Bd. xvi., pp. 265–277.

328. **Wunderlich, L.**—Hylobates entelloides (a specimen shot at Singapore). *Berichte Senckenb. Ges.*, 1886. Dec. 11, p. 60.

329. **Yarrel, W.**—"Notes on the internal appearance of several animals examined after death, in the collection of the Zoological Society." *Zoolog. Journ.*, 1835. Vol. v., p. 14.

330. **Ziehen, Th.**—"Die Grosshirnfurchen des Hylobates- und Semnopithecus-Gehirns." *Anat. Anz*, 1896. Bd. xi., pp. 470–481.

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V.

Cunning in Animals.

THE nature of this subject requires an introductory statement of the writer's interpretation of the terms "Instinctive Activities" and "Intelligent Activities." This is the more necessary in view of the wide difference which exists in the definitions of the many distinguished writers who have treated on the cause and effect of animal and human action.[1] I incline to interpret the term "Instinctive Activities," broadly, as those accomplished by congenital psychological impulse, without the aid of experience; and my definition of "Intelligent Activities" I take *in toto* from Lloyd Morgan's scheme of terminology, viz., "those due to individual control or guidance in the light of experience through association."

A full definition of "Instinctive Activities" should perhaps contain a reference to that possibility of variation or variableness which is necessary in view of evolution. My attempt to estimate the nature of cunning, however, has led me to catalogue it as inseparably connected with intelligence, and on this account the consideration of such activities as I term "instinctive" may be set aside. Dr. Reid, in his recently published work, "The Present Evolution of Man," forms an entirely different conception of instinct. He speaks of a "conscious adaptation," and of instinctive impulses as "ways of thinking and acting." Such attributes I would include in my understanding of the term "Intelligent Activities," and as directly connected with the particular subject of this paper.

Probably no more highly specialised example of cunning could be found among lower animals than in the resource of a hunted fox. In man we have a degree of cunning which, as exemplified in the wiles of a Red Indian or the ingenuity of the clever criminal, surpasses that of any lower animal. But the intelligence even of savage man, coupled with his reasoning intellect, gives him an advantage. Yet the marvellously keen sense action of the red man probably does not exceed the power of sense in the fox; certainly the sense of smell in the fox and in all allied animals completely transcends that in man. In all intelligent actions, therefore, which require the use of some special sense, these differences of primary capability must be kept in mind.

[1] "Some Definitions of Instinct," by Lloyd Morgan, NATURAL SCIENCE, vol. vi., p. 321, May, 1895.

Further, I venture to say that the custom of regarding the causes of animals' actions as simply elementary forms of human mental action has given rise to much confusion. It is much more difficult than at first sight may be supposed, to comprehend to even a limited extent such actions of lower animals as are controlled by senses the keenness of which we cannot know. When the fox, by the power of his senses, becomes aware of the presence of hounds, the immediate effort towards self-preservation is probably a compound of two pure instincts, viz., that of fear and that of self-defence. Thereafter his actions become voluntary, and are frequently guided by a high degree of intelligence and cunning. But the fox, when hard pressed, does not revert to native instinct in a desperate effort to combat his pursuers. His intelligence rather prompts him to more and more clever stratagems. Darwin ("Descent of Man," p. 80) refers to animals becoming more sagacious in localities where they are hunted, and considers that they do so largely through observing the experiences of other animals. Young animals can be trapped more readily than old ones, and they are less wary at the approach of man. "Even with respect to old animals," he says, "it is impossible to catch many in the same place and in the same kind of trap, or to destroy them with the same kind of poison; yet it is improbable that all should have partaken of the poison, and impossible that all should have been caught in a trap." Leroy, who was Ranger at Versailles, and has written largely on these matters, states that in districts where foxes are much hunted, the young cubs are much more wary than are even the old foxes in districts where no hunting is practised.[1] Rae also ("Animal Intelligence," p. 430)[2] has described how Arctic foxes become suspicious of gun traps, and how they manage to steal the baits by gnawing through the string attached to the trigger, or by tunnelling in the snow across the line of fire and drawing the bait downwards. Dr. Rae ascribes these clever devices to "abstract reasoning," but Lloyd Morgan points out, as Darwin might also have done, that they occur only after one or two foxes have been shot, and therefore a certain amount of experience gained through observation. Traps set at the mouths of fox 'earths' are also avoided by cunning. Leroy explains this in characteristic language. He says that the fox "smells the iron of the trap, and this sensation has become so terrible to him, that it prevails over every other." He then refers to the length of time a fox will remain in an earth, the entrance or entrances of which are guarded by traps, and how he will dig his way out in a new direction to avoid this terrifying smell of iron. Further, he states that if a rabbit runs from the earth in which the fox is concealed, and is caught by the trap, the fox "infers that the machine has done its duty, and walks boldly and securely over it." Romanes quotes

[1] "Lettres Phil. sur l'Intelligence des Animaux," 1802, p. 86.

[2] See also Lloyd Morgan, "Animal Life and Intelligence," p. 366.

largely from Leroy, and appears to consider his explanation of the above case quite satisfactory. We are, of course, unaware of how much odour an iron trap may afford to a fox, but we are also unaware, I think, that the animal is terrified by the odour, or that the terror should subside, or be suddenly overcome when the fox sees that the trap has caught an animal of some sort. A Lanarkshire gamekeeper, whom I have accompanied while trapping foxes, related the following case, which shows the superior cunning of old, as against young, foxes, and further does not involve the need to imagine that the trap has a terrifying odour. He set his traps at an earth with four entrances, a trap at each, being aware that the earth was inhabited by a vixen and her cubs. He succeeded in catching the cubs without difficulty, but the old fox seemed, by the appearance of tracks near the mouths of the earth, to be passing in and out unhurt, in spite of the traps. Day after day he found his traps empty. As the tracks became more numerous, however, he became convinced, by daily examination, that the vixen was simply jumping over the danger each night, returning to the earth by the same method. That she should have returned, with knowledge of an existing danger and after her cubs had been killed, does not argue for much terror on the part of the fox. The keeper caught her, however, by the expedient of setting his traps further away from each entrance, so that instead of jumping over she jumped on to one.

I do not, however, desire to belittle the importance of fear or terror in controlling the actions of animals. At the same time, it is not possible, in a short paper, to go into the results of fear, or even to discuss the "shamming dead" phenomenon, although it is often closely connected with cunning.

With reference, however, to that form of fear-instinct which is described as suspicion or wariness—an ever-present condition in the wild animal—I desire to quote from Romanes[1] an instance given by Leroy. With reference to the stag, he says, "Often (when not being hunted at all), instead of returning home in confidence and straightway lying down to rest, he will wander round the spot; he enters the wood, leaves it, goes and returns on his steps many times. Without having any immediate cause for his uneasiness, he employs the same artifices which he would have employed to throw out the dogs, if he were pursued by them." Romanes then says, "It is remarkable enough that an animal should seek to confuse its trail by such devices, even when it knows that the hounds are actually in pursuit; but it is still more so when the devices are resorted to in order to confuse *imaginary* hounds which may *possibly* be on the scent." From this he argues that there is a logic of recepts in animals, and probably also a logic of preconcepts. If we accept Leroy's account, it seems to me unnecessary to conclude, as Romanes evidently does, that the artifices of the stag are directed against the pursuit of hounds alone. To

[1] "Mental Evolution in Man," p. 54.

believe this, is to imply that the artifices are reasoned out independently to meet a special case, instead of being, as it seems to me they are, the outcome of an hereditary practice of caution or wariness. To argue further that the stag deliberately resorts to these devices, "to confuse *imaginary* hounds which may *possibly* be on the scent," is to interpret the actions from a purely human point of view, believing that because a man, under given circumstances, would imagine and do so and so, therefore an animal can arrive at a similar outward result by no other method. In the case of the stag, I see no reason to believe that any idea or 'construct' of hounds is formed. It is merely in interpreting the actions that this idea has been formed. Sir E. Tennent relates ("Natural History of Ceylon," p. 35) that the habit of the jackal, after having run down its prey, is to conceal it in the jungle and issue forth on a tour of observation lest any predatory enemy may be near, afterwards returning to the carcase. In cases where this has been observed, and the observer has been discovered by the jackal, it is further stated that the jackal may practise the ruse of seizing some object in its mouth and setting off with it, in the hope of misleading the observer. Both the stag and the jackal, it seems to me, are simply employing their intelligence or cunning in guarding against what we may justly describe as an ever-present dread of attack in certain experienced lines. They are not imagining special cases o attack, and having calculated the best means of circumventing them, carrying their studied plans into execution: such work is reserved for generals and field-marshals. When a herd of red deer lies down for the midday siesta the sentinel is always alert on some convenient eminence. When a weasel runs into a hole he invariably looks out almost immediately: it is an excellent time to shoot him. This is observation akin to the jackal's, but I need not attempt to imagine the weasel's reason.

The instance of the stag, however, leads us naturally to the most remarkable cases of cunning related of the fox. The device adopted by the stag though not pursued, would, if repeated during a hunt, produce one of the cunning stratagems fairly well known in hunting. A fox, having a good distance between it and the hounds, has been known after crossing a wall and running well into an open field beyond, to retrace its steps and strike off at right angles under cover of the wall. The hounds, clearing the wall, pick up the scent on the opposite side, run well out into the field and throw up their noses. This example is practically an accelerated version of the stag's case. Like every instance of a fox's cunning escape from hounds, it is a method which depends for success on the hounds being misled in the matter of scent. A foxhound is a marvellously stupid animal if it has no scent to guide it. A fox, if over-run by a pack of hounds, can double back and pass through the midst of the hounds, while they are intently searching the ground with their noses. A greyhound, on the other hand, is helpless unless it keeps the hare full

in view. It seems probable that experience has taught the fox that the particular creatures which pursue it do so by following the scent of its trail. Leroy's stag had probably acquired the same knowledge or percept. Both animals, therefore, acquire the habit of protection against being followed by scent. The devices which the fox can employ habitually in this way are too well known to require much exemplification. I shall, however, while shunning the familiar examples, take a single instance related to me by the eye-witness, a relative of my own, and a member of the Linlithgow and Stirlingshire Hunt. The hounds were drawing a cover on the south side of the Union Canal near Ratho. A fox broke cover, made straight for the canal and swam across. The hounds were taken along the side of the canal a short distance in a westerly direction, to where a tunnel passed below it. Through this they were taken to the other side of the canal and run back to the point opposite that at which the fox had plunged in. Here they at once found, but carried the scent along the bank in an easterly direction only for a short distance, attempts to trace it further being quite unsuccessful. My informant, who had been on the east side of the cover when the hounds were led off to the tunnel, and who had remained there to see if the hounds would 'find' on the other side of the canal, noticed a wet fox coming from the direction of the canal and making off towards the fields at the back of the cover. The hounds were therefore brought back to his side of the canal. There they 'picked up the scent,' and the whole company was presently heading towards Juniper Green. It happens, however, that the trail of a wet fox is difficult to follow, and, after the hounds had run through several gardens on the outskirts of the village of Juniper Green, reynard was given up. There seems no reason to suppose that the wet fox was any other than that started from the cover, which, recognising that the pursuers had gained the far side of the canal, swam quickly back to the side from which he had started.

If we attempt to estimate what a ruse of this description involves, we must first note that while in the cover, the fox, by means of its sense of hearing, smell, or sight, became aware of the approach of danger. The instincts of fear and of self-preservation then caused action. The conditions of wariness under which it lives, and the acuteness of its senses, unimpaired by any artificial conditions of life, probably enabled it to apprehend danger before the hounds became aware of its presence. At the same time, its intelligence, benefiting by experiences of life in a fox-hunting district and by association of circumstances, would enable it to form a more or less definite construct or series of constructs. Such constructs would be in some degree analogous to our human constructs, 'hounds' and 'hunters'; they would conform in a measure to our conceptions of the interpretations of these terms. The same experience rendered it unnecessary for the fox to define its constructs by examination—a feature

commonly to be observed in deer, and other animals possessed of marked curiosity. The baying of the hounds alone would probably be sufficient to enable the fox to form a fairly accurate definition. Seeking to escape from the cover without detection, but fully aware of the fact that its pursuers are able to follow its track, probably knowing that this following is by what we call scent, the fox runs with all speed to the canal. The reason for crossing the canal must necessarily be more or less matter of speculation, but in the case cited, no other direction of flight was unguarded or without danger, by reason of hounds or huntsmen and the 'field' generally. We might say, in a manner, that the fox was driven across the canal; and probably the first direction is not generally chosen by the fox so much as controlled by the limits put upon its escape. At the same time there seems a good deal of evidence to show that, when pursued, a fox readily seeks water which may be near. It is commonly believed that the fox knows that scent is lost in water, and further, that if its body is wet its scent even on the ground is much less. So Leroy would unhesitatingly say that the fox seeks to wet himself in order that his track may be more difficult to follow. It is safer to believe, however, that the fox seeks only to escape, and has experienced that, having swam or run along through water, temporary respite from pursuit is obtained. This in itself would be quite sufficient to account for a hunted fox taking readily to water. Delay in pursuit being associated with this passage through water, and the animal having in all probability, as we have already hinted, a knowledge that the track is followed by scent, it seems possible that by intelligence, but without the process of reasoning, devices may be adopted by which the difficulties of the pursuers will be still more increased, as when a fox, coming to a shallow stream, enters the water and runs for some distance in the track of the stream before quitting it. In the case in point, the fox was too closely followed to spend time in the water, but, having reached the other side, its acute senses no doubt made it aware that, by some means or other, hounds were coming towards it along the newly-gained canal bank. Confronted with this sudden development, it evidently did not put any confidence in its wet trail, but rapidly, having gone along the bank as far as it safely could, it repeated the device of crossing the water. This, be it noted, entirely defeated the hounds.

I am, therefore, inclined to think that no higher process of intelligence is required than that which may be described as the purely animal one, in order that manifestations of cunning may be explained; and further, that the desire to attribute rational and highly intellectual processes, springs from the easily acquired practice of explaining animal actions by purely human formulæ.

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SOME NEW BOOKS.

Coal-Measure Molluscs.

A Monograph on Carbonicola, Anthracomya, and Naiadites. Parts I., II., and III. By Wheelton Hind, M.D. Pp. 181, xxi. pls., circa 600 figg. Palæontographical Society, 1894–1895–1896.

The present Monograph deals with the genera, better known by the names of *Anthracosia*, *Anthracomya*, and *Anthracoptera*. While confined to a description of British species, its author has explored various continental museums, in order to determine the identity of species recorded by European writers, and a critical bibliography of twenty-four pages deals with the literature relating to the subject from the year 1720. This bibliography illustrates how often unnecessary labour has been undertaken by authors unacquainted with the literature of their subject. It is on the whole a valuable contribution, though some of the comments on previous authors will not meet with general acceptance.

The replacement of "*Anthracosia*" by "*Carbonicola*" is regrettable on account of the wide-spread use of the former. It is questionable, also, whether it can be supported on strict grounds of priority. King put forward the term "*Anthracosia*," in 1844, for "a group of Unionidæ characteristic of the Coal Measures," but neither described nor figured specimens. It was a "preliminary notice" of the worst sort, and was not recognised by McCoy when, in 1854, he proposed the name of "*Carbonicola*" for the same group. McCoy failed, however, to understand the genus he described, and his diagnosis could only have been drawn up from specimens of other genera from a younger formation. This was pointed out by King, who repudiated the genus as in any way relating to the Coal-Measure *Unios* known to him, which he then described in detail and correctly. Dr. Hind agrees in the main with Professor King upon the question of McCoy's faulty diagnosis. McCoy failed to publish figures of any species of his genus, and under the circumstances it would seem better to have taken King's later paper of 1856 as the starting point, and to have retained *Anthracosia*, the diagnosis of which was clear and good.

Before entering upon a description of the various species of *Carbonicola*, the author defines what he regards as a species. He has felt it necessary "to give specific rank to any forms which seemed to be typical of a bed; in other cases, when in the same beds a series of varieties occurred, to include them under one species." This seems a curiously retrograde step—specific character is made a resultant of stratigraphical position, just as in the old days of cataclysms and creations, and a check is thus placed on all endeavours to work out the development of a genus and the mutual relations of its forms. Moreover, this has not even the effect the author aims at, viz., "as an aid to determine the horizons," for that which is defined by a horizon cannot also define a horizon. The only excuse for this course would be some proof that all the "varieties" included in the same bed were derived from a common stock; but the author neither defines

his conception of a "variety," nor attempts any such proof. The remarkable variation of form which obtains in this genus is more than once commented upon; but we think that its importance was not sufficiently recognised in dealing with species, nor does it seem to have been noted that a large series of specimens from any one of several horizons furnish the most gentle gradation between several so-called species. Several of the species described in the Monograph are clearly but varieties of others. A good example of this is given on plate ii., where fig. 3 does duty as a somewhat rotund example of *C. robusta*, and figs. 7 and 8 as examples of *C. rugosa*. The majority of palæontologists would unhesitatingly put *C. rugosa* as a variety of *C. robusta*, a view held by Salter. The author has failed to find more than two specimens of *C. rugosa*, and neither of them seems to be complete.

The same failure to distinguish what constitutes a species is seen in the case of the genus *Anthracomya*. Fig. 4, plate xiii., represents the type-specimen of *A. dolabrata*, and is therefore not open to question. Six other figures on the same plate are said to represent specimens of this species, but to us they agree much more closely with *A. adamsii*. The only other figure upon this plate which could belong to *A. dolabrata* is fig. 14, and is labelled *A. modiolaris*. A comparison of fig. 4, the type, with fig. 5, which should be the same species, will show that the ventral border of the type is almost parallel with the hinge-line, while in fig. 5 it rapidly falls away from it posteriorly. If the hinge-lines and ventral borders of the figures upon plate xiii. be projected forwards with pencil until they meet, the resultant angles of forms said to belong to the same species are very instructive.

The genus *Carbonicola*, as now constituted, includes eighteen species, of which five are new. Two species are founded upon only two specimens each, and a somewhat similar occurrence is noted under *Anthracomya*, where two species are founded upon one specimen each, in one case an internal cast. Remembering the great variation of form, it is difficult to understand what good purpose can be served by the creation of species such as these.

The value of the specific forms of *Carbonicola* is not clearly determinable in the Monograph. *C. acuta* runs off in one direction into *C. robusta*, in another it first merges into *C. subconstricta*, and then passes on into *C. aquilina*; in still another direction it becomes *C. ovalis*, which Dr. Hind acknowledges to be little better than a variety. *C. obtusa* seems identical with *C. ovalis*. If *C. polmontensis* be a good species, then figs. 11 and 15 of plate vii. ought to belong to this species, although regarded as *C. subconstricta*; but the value of the former is doubtful, and the latter are almost certainly internal casts of *C. robusta*. The specimens figured 6 and 7, plate ix., are taken as types of *C. aquilina*, but they might equally well serve as elongated forms of *C. acuta*, and it is comparatively easy to find a place for them in a series from a single horizon, which would lead up to *C. robusta*.

Taking *Carbonicola* as a whole, it would seem that the genus started with a form of which *C. antiqua* might well serve as type, and that variation took place along several lines, and we believe upon the same line more than once. It therefore happens that between most of the recognised species there are all sorts of intermediate forms. Not unfrequently in our experience a mass of 50 to 100 specimens collected from one small area of a "mussel band," has yielded at least four species and the necessary intermediate forms. A reference

to the distribution tables at the end of Part II. shows how often half-a-dozen species occur at the same horizon. The author would have rendered good service had he dealt at some length with the varietal forms, and the connection between species which could be established by them.

The genus *Anthracomya* is regarded as closely related to *Carbonicola* on the one hand, and the *Mytilidæ* on the other, and if not byssiferous in the adult, at least with a byssiferous ancestor or byssiferous fry. Sixteen species and four varieties are recorded. We have already alluded to the unsatisfactory nature of four species, and may mention in passing that the author admits the single specimen upon which *A. obovata* is founded "may be a deformity or even a hybrid." A form previously described as *A. carinata* is now placed as a variety of *A. minima*, since a series of intermediate forms completely connects the two. The species of *Anthracomya* are well defined on the whole, and there is an absence of that provoking, because not fully understood, tendency of one species to slide off into another.

In discussing the relationships of *Naiadites* (*Anthracoptera*), on p. 127, the author omits to contrast or compare it with the genus *Anthracomya*, although previously (p. 123) he has admitted a very close resemblance in both crushed and perfect examples. The difference upon which he relies in distinguishing the two genera, *i.e.*, the position and shape of the umbones is one of degree rather than of structure. On the whole, there is a much closer approximation in *Naiadites* to the *Modiola* and *Mytilus* type, although in one or two species even the author has failed at first to distinguish the genus. Eight species of *Naiadites* are described, two of which are new.

It is possible that the author has allowed several species to stand against his better judgment, for fear he should be thought iconoclastic, since he is well aware, for example, of the close relationship between *N. carinata*, *N. modiolaris*, and *N. triangularis*, and considers it would be perfectly justifiable to make them all into one species, a sentiment with which we cordially agree. We would go one step further, and put *N. elongata* as a variety of *N. modiolaris*, from which it would seem to have been derived by way of *N. triangularis*.

A series of diagrammatic sections forms the closing part of the monograph, and serves to indicate the stratigraphical position of the various species.

Dr. Hind would add considerably to the value of a succeeding monograph if he described the shell with greater uniformity. For want of this it is often extremely difficult to compare a couple of descriptions, or determine their relative value. The figures are good, but, if anything, too numerous; thirty-six figures, for example, of *C. aquilina* occur upon one plate.

Notwithstanding the various objections here raised, and the signs of great haste shown by the Monograph, we welcome it as a needed contribution to the literature of the Coal-Measures, and as likely to incite further study of the Mollusca of the series. H. B.

THE RECORD OF BIG GAME.

"RECORDS OF BIG GAME: containing an Account of their Distribution, Descriptions of Species, Lengths and Weights of Horns, and Field Notes." Square 8vo., pp. xvi. and 325, Illustrated. London; Rowland Ward, 1896. Price 30/- Nett.

THE present is a record-making age, and it is therefore no matter of surprise that Mr. Rowland Ward's "Horn Measurements" has reached a second edition within the comparatively short time of about

four years. In its present extended form the book is a great improvement on its predecessor, and, indeed, can no longer be regarded as a mere list of horn measurements, but forms, to a great extent, a valuable guide to the distribution—and, in some instances, to the habits—of the animals coming under the designation of Big Game. Especially is this the case with the African antelopes, in regard to which a series of interesting notes are communicated by that well-known observer and sportsman, Mr. H. A. Bryden, and it seems almost a pity that other authorities were not engaged to perform the same office for the animals of other regions.

As so many additions have been made to the genera and species of African antelopes of late years—to say nothing of emendations of the generic and specific titles of the previously-known forms—the book will be found a valuable guide to this group of ungulates to those who are unable to obtain the expensive memoir of Messrs. Sclater and Thomas. Indeed, almost the only fault we have to find with this part of the work is that in quoting from the original descriptions of several species, such as *Madoqua phillipsi* and *M. swaynei* (pp. 104, 105), *Cobus penricei* (p. 121), and *Cervicapra chanleri* (p. 137), the author has retained the "n. sp." after each name. The spelling of some of the popular names, as Lechwe, for the simpler Lichi, is, moreover, not to our personal liking, although it must be confessed that such matters are largely dependent upon the individual taste of the writers. So far as we can see, the list of antelopes is wonderfully complete, and includes such recently-described forms as *Cobus penricei* and *C. thomasi* (1895). Curiously enough, *Dorcatragus megalotis*, described in 1894, appears, however, to be omitted—at least, this name does not occur in the index. But then, is the index so to be trusted? We have tested it only in one place, where we found the following:—

Oreas canna	212
Oreotragus derbianus	116
——— *saltator*	212

This should read:—

Oreas canna	212
—— *derbianus*	212
Oreatragus saltator	116

We are not going to make this slip a reproach to the author, as we know too well, by sad personal experience, how exceedingly difficult it is to attain accuracy in such matters; but we would suggest that in the next edition the book would be vastly improved by a systematic index at the beginning.

With respect to the special object of the book—the measurement of the horns, antlers, tusks, and skins of Big Game—the author has evidently spared no pains, and he has in many cases been enabled to increase the "records" of the previous edition. Every sportsman will in this portion of the work find a mine of interest, and the scientific naturalist will likewise not fail to discover matter worthy of his attention.

In the matter of illustrations, the present issue contrasts most favourably with its predecessor, the number of cuts of heads having been greatly increased. Nearly all of these are excellent portraits so far as the actual delineation is concerned. But, for our own taste, many of them are far too "chalky." This is especially noteworthy in the case of the eland head, figured on page 211, which in this

respect forms a marked contrast with that of the serow on page 219. We should also like to ask why the figure of the eland's head is lettered :—

"Eland (*Oreas canna*)
Eland (*Oreas derbianus*)."

Surely it belongs to one or other of those two well-defined species, and is not a "composite portrait."

Such criticisms as we have made will be seen to refer to unimportant points of detail. And we have much pleasure in congratulating Mr. Rowland Ward on the production of a work which must be invaluable to every hunter of Big Game, and which is a monument of untiring and successful energy on the part of its author.

R. L.

VOLES AND LEMMINGS.

GENERA AND SUB-GENERA OF VOLES AND LEMMINGS. By Gerrit S. Miller. No. 12 of the North American Fauna Series. 8vo. Pp. 1–76, with 3 plates and many text-figures. Published by the United States Department of Agriculture, Washington, 1896.

No want perhaps has been more felt of recent years by mammalogists and writers on geographical distribution, than a careful and critical comparison between the mammals of Boreal North America and those of our Palæarctic Region. And such a comparison has been nowhere more needed than with the members of the sub-family Microtinæ, the Voles and Lemmings, a group highly characteristic of—indeed almost confined to—these two parts of the world, and one in which, while the Old and New World species were each by themselves as much confused as they well could be, no serious comparison at all had ever been instituted between the corresponding forms of the two sides of the Atlantic.

Such a comparison combined with a revision of the whole group, Mr. Miller has now made, in the only way in which it was possible, namely, by crossing the Atlantic and working out the European forms in a European Museum, after having previously gained a thorough knowledge of the American ones. We are pleased to note that Mr. Miller says our National Museum offers exceptional facilities for such a study, and we hope that he, and others, will make again such an admirable use of these facilities as he has done in the paper before us.

The astonishing confusion that has hitherto existed in the nomenclature and arrangement of the group may be partly gauged by the fact that for the twenty genera and sub-genera he recognises, Mr. Miller has had to discuss the claims to adoption of more than fifty names, while half a dozen widely different systems of classification have had to be discussed and—dismissed.

The results as a whole seem to be excellent, and this could hardly fail to be the case from the happy combination of abundant material, common-sense, care, and exhaustiveness, with which we know the work to have been done, and we have therefore practically no criticisms to make. Moreover, owing to the fact that the author does not attempt to deal with species, we are not confronted with that crowd of new names which, whether sound or not, appal the old-fashioned naturalist in most modern American work.

As usual in the series, the illustrations are numerous, clear, and admirably adapted to their purpose, and will help students to realise the characters of many rare forms, of which specimens are not available on this side of the world.

O. T.

The Sports of Animals.

Die Spiele der Thiere. Von Karl Groos, Professor der Philosophie in Giessen. Pp. xvi., 359. Jena: G. Fischer, 1896. Price 6 marks.

Professor Groos, in an interesting preface, discusses the relation of his subject to the psychology of man, holding that all sides of the life of the lower creatures may throw light upon man, since among them may be studied the incipient stages of what becomes more highly developed in the higher creature. To the well-known proposition so ably developed by Lewes and Spencer, and shown by Dr. Groos to be due to Schiller, that the frolics of young creatures are an expression of exuberant energy, an overflow of nerve force, he adds the other suggestion that they frequently are a preparation for the important duties of adult life. As a little girl trains herself for a future maternity by devotion to a doll, so the kitten or tiger-cub playing with a ball may be training itself for its future catching of living prey.

The first chapter discusses at length the theory of superfluous energy as the cause of play. Admitting to the fullest the physiological importance of the principle, the author shows that the root of the matter lies deeper. Animals and men tire themselves out at their games: a dog that has returned from a long walk and is slouching listlessly along with its tongue out of its mouth, if it meets another dog will begin to gambol with it. By instances from many authors he leads up to the conclusion that there is a close connection between instinct and play, and that a deep-seated biological cause must be found for this.

The second chapter developes this theory of the connection between instinct and play. In a long review of the interpretations placed upon instinct by earlier writers, Dr. Groos gradually makes plain that he adheres most closely to Weismann's conception of instinct as a congenital property built up chiefly by selection and owing little, if anything, to inheritance of acquired characters. In the case of higher animals instinct becomes more and more merged in intelligent action. He believes, not that these higher animals play because they have youth as a time of overflowing energy, but that they have youth in order that they may play. Their instincts operate before they are needed for the real business of life, and the continual exercise of them in play changes the cast-iron congenital instinct into a more flexible habit, readier of adaptation by the intelligence to the varying exigencies of real life.

In the third and longest chapter of the volume Professor Groos has brought together in a systematic fashion an enormous collection of the facts regarding the play of animals. He classifies plays as follows:—(1) Experimental, in which the very young of all the higher animals, as soon as they arrive at the independent use of their faculties, or limbs and jaws, restlessly examine and experiment with every object that comes within their reach. Among these experiments, for instance, he puts the case of Miss Romanes' young monkey which took the greatest pleasure in learning to unscrew and rescrew the handle of a brush. (2) Locomotion, in which young animals practise their future modes of movement. Such are seen in the racing and chasing of young dogs, in the vertical jumping of young mountain-dwellers like chamois and goats, or in the distance jumping of young buck. (3) In the hunting games of the young, the instincts tending towards future use, are more clearly in evidence. Young lions, tigers, and cats play with inanimate objects like balls or stones, pushing

them about and catching them when in motion, or chase living objects like the tail of their mother. (4) Games of combat—the innumerable instances of these which are known seem to him to imply chiefly a preparation for future combats between males for the possession of females. He believes that the instinct to challenge and to murder among all kinds of creatures is almost entirely confined to males. And so in the further divisions of (5) games of love, including the quest of bright colours and the practice of songs and cries, of (6) architectural games, and (7, 8, and 9) games involving respectively duties, imitation, and curiosity, the Professor carries out his general thesis of the gradual replacement of instinct by experience.

The psychologist will find a great deal of Professor Groos' book worthy of study. Its theory of attention and the gradual evolution of attention from curiosity is novel and interesting. From the point of view of the biologist, the most interesting part is the attempt to place a new meaning upon the period of youth, and to bring the activities of youth under the influence of natural selection.

GEOGRAPHICAL DISTRIBUTION.

A GEOGRAPHICAL HISTORY OF MAMMALS. By R. Lydekker. (Cambridge Geographical Series.) Pp. xii. and 400. Cambridge: University Press, 1896 Price 10s. 6d.

THAT of all the great sub-divisions of the animal kingdom, the mammals supply the most important evidence in questions relating to the former distribution of land and water, was long ago recognised by Wallace. Their limited means of dispersal, the great abundance of their fossil remains, and the consequent relatively complete knowledge of their past history are the chief factors which give them this special importance. It is true that of Pretertiary Mammalia little is known, and therefore other groups must be employed in attempting to determine the distribution of land and water in the earlier geological periods; but in later times, from the Lowest Eocene upwards and in many quarters of the globe, numerous mammalian faunas have been discovered which supply the strongest available basis for such speculations. This being the case, a volume on the distribution of this group, written by one who is equally familiar with living and extinct forms, will be peculiarly welcome both to zoologists and geologists. Such a book had indeed become a necessity, so great have been the advances in our knowledge of the Mammalia, particularly of the extinct forms, during the last few years, whole faunas having been discovered and described, which throw floods of light on many disputed questions, and render necessary a revision of many previously accepted opinions. The present volume supplies just what was wanted, being thoroughly up-to-date, and clearly and impartially written.

The sub-divisions of the land areas of the globe adopted by the author are very similar to those suggested by Blanford in 1890. Three great "realms," the Notogeic, Neogeic, and Arctogeic, form the main divisions; of these, the first includes the Australian, Polynesian, Hawaiian, and Austro-Malayan "regions"; the second, the Neo-tropical region only; the third, the Malagasy, Ethiopian, Oriental, Holarctic, and Sonoran regions. The advantage of this scheme is that it throws into strong relief the extreme distinctness of the Australasian and South American faunas; on the other hand, the "regions" are of very unequal value. Perhaps the most interesting and important parts of the book are the chapters on the Notogeic and Neogeic realms. The origin of the Marsupials of Notogæa is dis-

cussed at considerable length, and Mr. Lydekker comes to the conclusion that the Didelphidæ and Dasyuridæ probably originated from a common stock in South-Eastern Asia about the end of the Cretaceous period. The members of the first-named family afterwards migrated into Europe and Asia, thus accounting for their sudden appearance in the Oligocene deposits of those areas, while the Dasyuridæ, on the other hand, passed into the Australian region, where, being isolated, they gave rise to the highly differentiated and specialised Marsupial fauna, including the Diprotodontia. The differentiation of the latter probably took place at a very early date, since among the Australian types of Marsupials lately discovered in the Miocene of Patagonia, certain forms already exhibit the diprotodont modifications in the lower jaw. It is, of course, possible, and perhaps even probable, that this modification may have arisen independently in the S. American forms, but in any case it is hardly likely to have occurred there sooner than in the main centre of the group, Australasia. The former existence of an Antarctic continent, the relations of the Ethiopian fauna to that of S. America and of Madagascar, and many other questions of like interest will here be found thoroughly threshed out, all available evidence being brought to bear upon them.

In short, it may be said that this work is a very valuable contribution to the study of distribution, and should be read by all who are in any way interested in such problems. At the same time, it is not without defects, the more to be regretted, because in most cases they could easily have been avoided. For instance, in Fig. 12, the fact that the feet there represented are certainly not those of the elephant and hyrax, as stated in the legend, will be at once obvious to everyone, particularly to the author. Again, the statements that "the Soricidæ or Shrews are represented in Ethiopia only by three species," and that the Potamogalidæ are represented in Madagascar by *Microgale* (p. 234), are incorrect. In the last case *Geogale* is clearly intended, and, indeed, on p. 219 it is described as being a Malagasy representative of *Potamogale*.

The printing and illustrations are, on the whole, good, but the mingling of wood-cuts and process-blocks has a somewhat unpleasing effect.

The Geography of Plants.

Manuel de Géographie Botanique, par Oscar Drude, traduit par Georges Poirault, et revu et augmenté par l'auteur. Livraisons 11–13, pp. 401–512. Paris: Klincksieck. Prix de chaque livraison, 1 fr. 25 ct.

We are glad to see that the French translation and edition of Oscar Drude's useful work on Plant Geography is so nearly finished, and shall hope soon to have the opportunity of reviewing the work as a whole. Meanwhile, we may mention that the present issue brings us nearly to the end of Part V. "The regions of vegetation of the earth arranged in geographical order." It contains the concluding pages of Chapter ii. on "Northern Floral Regions," the whole of Chapter iii. on "Tropical and Southern Floral Regions," while Chapter iv., on the "Oceanic Floral Region," begins on p. 511. The bibliography at the beginning of each section is a useful feature, and we would suggest that every effort be made to render it as complete as possible. A good deal of work has recently been done both in this country and in Germany on the flora of Tropical Africa; but while reference is made to that of Prof. Engler and his colleagues, work done at Kew and the British Museum during the last few years is almost ignored.

BOTANY FOR SCHOOL CHILDREN.

HOW TO STUDY WILD FLOWERS. By the Rev. George Henslow, M.A., F.L.S. 8vo. Pp. 224, with 57 illustrations. Religious Tract Society, 1896. Price 2s. 6d.

"THE object of this book is to enable students to rapidly acquire an *accurate* knowledge of typical British wild flowers." "If teachers would place this book in the hands of their pupils, make them dissect and examine the flowers with its aid, and above all things *insist upon accuracy*, the great use of botany in schools, viz., the *training the young minds in systematic observation and accurate habits*, will be secured." The sentences we quote occur in that portion of Mr. Henslow's preface which is addressed to the teacher. And under certain conditions his book fulfils all that he claims for it. The conditions are an elementary knowledge of the general structure of seed-plants, and a teacher who has learnt some of his botany out in the fields and woods. From p. 49 onward the book is really a small British flora. Descriptions are given of the more commonly occurring genera or species, and the illustrations, the majority of which are good, will be a valuable help to the student. The addition of remarks on points of biological interest, serves somewhat to remedy the dryness incident to a mere systematic account. The thirty-six pages of introduction comprise a brief review of floral morphology, but must not by any means be regarded as an efficient introduction to the study of flowers. It will help the student to unravel the intricacies of the artificial key to the orders and genera (pp. 42–48), but if he is wise he will let this alone and trust to a teacher or friend until he is able roughly to allocate to their orders the more commonly occurring plants. The book is of a handy size and nicely got up, and looks very attractive in its neat red binding.

NOMENCLATURE IN ENTOMOLOGY, AND IN ZOOLOGY.

RULES FOR REGULATING NOMENCLATURE, with a view to secure a strict application of the Law of Priority in Entomological work. Compiled by Lord Walsingham and John Hartley Durrant. 8vo 18 pp. London: Longmans, Green. November 2, 1896. Price 6d.

LORD WALSINGHAM and Mr. Durrant have compiled a list of the Rules which regulate work done in entomology at Merton Hall. They have called them the "Merton Code." No one can offer the least objection to these gentlemen conducting their researches in an extraordinary manner, but we do not suppose other entomologists will accept the result.

The note to Rule 12 encourages the priority-maniac to flood us with hektographic copies of his new names, provided he fulfils certain conditions as to sale by publisher.

Rule 20 provides that "a name homophonous (*i.e.* differently written, but indistinguishable in sound) with a valid name is invalid," etc., "*e.g.*: *Ucetia*, Wkr. would invalidate *Eusesia*," a proposition arguing a peculiar standard of pronunciation among entomologists, and apart from that scarcely short of the ridiculous.

But Rule 21 goes even beyond this, in stating that "a name so similar to a valid one as to be almost homophonous or almost homonymous is invalid," etc.

Rule 25 states that "a name which is offensive (whether politically, morally, or by its irreverence) is invalid, and should be expunged from zoological nomenclature." *Philosophia stemma non inspicit*, and *Meretrix*, *Priapus*, *Orchis* do not suggest indelicacy to

everyone. We do not see the necessity of introducing a vigilance committee into zoological literature.

The use of undefined names may be considered justifiable by some, but others, who have an equal right to an opinion, refuse to recognise *nomina nuda*, even if accompanied by the specific form introduced into the new genus, such as occur in the works of Fitzinger, Locard, Kuntze, Pomel, Dejean, and others.

We may take this opportunity of referring any readers interested in nomenclature to the excellent address on the subject delivered by Professor T. Gill as Vice-President of Section F, Zoology, of the American Association, and published in *Science* of October 23 last.

The Prices of Books.

In consequence of complaints made that in the last number of Natural Science the prices of several of the books reviewed were not given, we must apologise to our readers. At the same time, we wish to state that we do our best to ascertain the prices of all books sent to us. It is not yet every publisher that sees the wisdom of enclosing with the books that he sends us a statement of their price, and the constant writing of letters which this entails adds considerably to an editor's duties. One of our correspondents particularly complains that the Geological Survey does not advertise its publications as it should do. The same is the case with other Government establishments, to some of which we have already made successful representations, and we trust that the Director of the Survey may feel inclined to follow their example. The prices of the books reviewed in our last number are :—

Semon's Travels, 15 marks	Tyndall's Glaciers, 6s. 6d.
Gregory's Jurassic Bryozoa, 10s.	North's Roman Fever, 25s.

Other Literature Received.

Report of the Horn Scientific Expedition, pts. iii. and iv.: Dulau. Problems of Biology, G. Sandeman: Sonnenschein. Round the Year, L. C. Miall: Macmillan. Versuch einer Philosophischen Selektionstheorie, J. Unbehaun: Fischer, Jena. Artistic and Scientific Taxidermy and Modelling, M. Browne: A. & C. Black. Royal Nat. Hist., pts. 35 and 36, R. Lydekker: Warne. History of Mankind, pts. 11, 12, and 13, F. Rätzel: Macmillan.

Submarine Leakage of Artesian Water, R. L. Jack: *Proc. R.S. Victoria.* La Réproduction et l'évolution des guèpes sociales. Observations sur les Polistes, P. Marchal: *Bull Soc. Zool. France.* New Zealand Diptera, P. Marshall: *Trans. N.Z. Inst.* Intestinal Tract of Birds; Anatomy of Hoatzin, P. C. Mitchell: *Proc. Zool. Soc.* Fatigue in Reading, H. Griffing and S. I. Franz: *Psych. Rev.* Description of two n. gg. and n. spp. of Australian Fishes; New Family of Australian Fishes, J. D. Ogilby: *Proc. Lin. Soc. N.S.W.* The Witwatersrand, G. F. Becker: *Nat. Geogr. Mag.* Schistosity and Cleavage, G. F. Becker: *Journ. Geol.*

Trans. Perthshire Soc. Nat Science, vol. ii. Fac. Agron. Vet. La Plata, Nos. xix., xx., xxi. Essex Naturalist, October, 1896. Veterinarian, November. Nature, October,22, 29, November 5, 12, 19. Literary Digest, October 17, 24, 31, November 7. Revue Scientifique, October 24, 31, November 7, 14. Irish Naturalist, November. Feuille des jeunes Naturalistes, November. Nature Notes, November. Amer. Journ. Sci., November. Naturæ Novitates, October 19. Amer. Naturalist, November. Science, October 16, 23, 30, November 6. Scott. Geogr. Mag., November. Science Gossip, November. The Naturalist, November. Westminster Review, November. Amer. Geologist. October, November. Botanical Gazette, October. Review of Reviews, November. Pop. Science News, October, November. Knowledge, November. Photogram, November. Psychological Review, November and Supplement iii. L'Anthropologie, September–October. Bull. Geol. Inst Upsala, vol. ii., part 2. Victorian Naturalist, September.

OBITUARY.

HENRY TRIMEN.

BORN 1843. DIED 1896.

HENRY TRIMEN, like so many of the naturalists of the generation which is rapidly passing away, was educated for the medical profession and took his M.B. degree, but never practised. In 1867 he became lecturer in botany at St. Mary's Hospital and in 1869 entered the department of botany of the British Museum, as assistant to Mr. Carruthers. He remained at the Museum till 1879, when he accepted the post of Director of the Botanical Gardens, Ceylon. Dr. Trimen (as he was generally known) was an enthusiastic botanist, and his work as a field-botanist at home, as a curator in the great national herbarium, and in the wider scope as director of botanical enterprise in Ceylon, was thorough. The "Medicinal Plants" (1880) in four quarto volumes, in which he had the assistance of Professor Bentley, is one of the most valuable works of its kind. "The Flora of Middlesex," which he published conjointly with Mr. Thistleton Dyer, is an example of what a county flora should be, and his "Flora of Ceylon," which unfortunately remains unfinished, will take a high place among those of our colonies. Nor must we omit to mention his services to science as editor of the *Journal of Botany* (from 1872 to 1879), in the next issue of which a portrait and memoir are promised.

HENRY NEWELL MARTIN.

BORN 1849. DIED OCTOBER 30, 1896.

DR. MARTIN has not long survived his resignation of the Professorship of Biology in the Johns Hopkins University. He was a graduate of Cambridge, England, and a Fellow of Christ's College. His best known work was written in conjunction with Professor Huxley, and is "Practical Instruction in Elementary Biology"; his physiological text-books, written while in America, are still extensively used in the colleges and schools of the United States. Dr. Martin's "Human Body" has gone through seven editions; and a memorial volume of his papers was issued a few years ago. An appreciative notice by Professor Michael Foster appeared in *Nature* for November 19.

THE death is announced of the eminent French botanist, AUGUSTE ADOLPHE LUCIEN TRÉCUL, at the age of seventy-eight. Mr. Trécul's work has extended over the last half century, and his communications to various French scientific journals number 154 in the Royal Society's catalogue. The greater number will be found in the *Annales des Sciences Naturelles* from 1843 onwards, and in the *Comptes Rendus* of the French Académie des Sciences. They are chiefly concerned with the anatomy and morphology of seed-plants. Among the many subjects at which Mr. Trécul worked we may mention the following—the origin of roots and buds, secondary growth in thickness in the stem of dicotyledons, laticiferous vessels and sacs, leaves, the nucleus, chromatoplasts, the origin and structure of starch grains, yeast and fermentation. He also published numerous valuable papers on the structure of different members of the *Nymphæaceæ*, and a useful monograph on the *Artocarpeæ*. *Treculia*, a genus of the latter order, was named in his honour by Decaisne. Mr. Trécul was a member of the Institute. He died on October 17 last.

MORITZ SCHIFF, born at Frankfort-on-Maine in 1823, died at Geneva, where he was professor of physiology, on October 6th. After studying at Heidelberg, Berlin, Göttingen, and Paris, he was appointed director of the ornithological department in the zoological museum at Frankfort, but his revolutionary tendencies did not find favour at German universities, and in 1854 he was glad to accept the professorship in comparative anatomy at Berne. In 1863 he migrated to Florence as professor of physiology, but hurting the susceptibilities of the Italians by his experiments on living animals, was obliged to return to Switzerland, where he was received by the University of Geneva in 1876. His physiological researches, dealing chiefly with the nervous system, but also with other branches, have quite recently been republished in the form of a jubilee Festschrift by his admiring students.

AN account of JOSIAH DWIGHT WHITNEY, whose death we chronicled in our October number, is given in the *American Journal of Science* for October. Born in 1820, he graduated at Yale College in 1839; in 1855 was appointed State Chemist of Iowa, then State Geologist of California, and in 1860 was made Professor of Geology at Harvard, a position which was guaranteed him for life in consideration of the gift of his geological library. He was all his life engaged in geological research; his field work included a survey of New Hampshire, a geological exploration of the Lake Superior region, and a survey of the mining regions of all the States east of the Mississippi. He published several Reports on his work, also a book on the metallic wealth of the United States, and in 1869 "The Yosemite Guide-Book." America has lost in him one of her ablest geologists.

In chronicling the death of LUIGI PALMIERI, the well-known vulcanologist, we had no space to give details. He was born at Faicchio; occupied the chair of mathematics at three Italian Universities, and then that of physics at Naples. In 1854 he was appointed Director of the Observatory at Vesuvius, a post which he occupied with the greatest distinction till his death. Regardless of personal danger, he studied all the eruptions of the volcano, and published a book on that of 1872. He was also the editor of the annual publication, *Annales de l'Observatoire du Vésuve*, and an inventor of several scientific instruments, notably a rain-gauge and a seismometer.

THREE eminent medical men have lately died. SIR JOHN ERIC ERICHSEN, Surgeon Extraordinary to the Queen, was born on July 19, 1818, and died at Folkestone on September 23 last. He filled successively the posts of Professor of Surgery at University College, Surgeon to the Hospital, Emeritus Professor of Surgery, and at the time of his death was the President of the College. He had also been President of the Royal College of Surgeons, and of the Royal Medical Society, and had occupied other honourable positions. His chief work was the well-known "Science and Art in Surgery." SIR GEORGE MURRAY HUMPHRY, who was born in 1820, died on September 24. He had lived more than 50 years at Cambridge, and was, to quote the *Times*, "one of the greatest benefactors to the University of modern times," in that he placed the teaching of natural science on a firm and permanent basis. He was appointed Professor of Anatomy in 1866, and in 1883 accepted the Chair of Surgery. His best known writings are "A Treatise on the Human Skeleton," 1858; "On Myology," 1872; "Old Age and Changes incidental to it," 1889. GEORGE HARLEY was born at Haddington in 1829. After graduating in medicine at Edinburgh, he studied in Paris and other Continental centres, and on his return to England held a Professorship at University College. In 1859 he became Physician to University College Hospital. Dr. Harley specialised on the liver and kidneys, and was an exponent of the A.C.E. mixture for anæsthetics. In 1877 he published a book on spelling reform.

OUR obituary list has been so heavy of late that we can do little more than mention the following:—F. C. S. ROPER, botanist, at Eastbourne; ALEXANDER S. SMITH, of Cumberland, who possessed a unique knowledge of bird life on the Solway marshes, and gave many valuable specimens to the Carlisle Museum; on September 10th Dr. R. ZANDER, botanical assistant in the Agricultural College at Berlin; on September 26th, at Berlin, the botanist, L. RUDOLPH, aged 83; the coleopterist, Dr. E. EPPELSHEIM, an authority on Staphylinidæ, in Bavaria; Dr. MAX MÜLLER, an eminent surgeon

and scientific writer, at Cologne, on September 3rd; at Bonn, on August 13th, Professor J. L. DELBŒUF, professor of psychology at Liège, aged 65; Professor RICHARD AVENARIUS, a psychologist of Zurich; Professor SCHNETZLER, formerly in the Chair of Science at Lausanne University, aged 72; in Alençon, on September 1st, C. G. GILLET, the well-known mycologist, aged 91; R. v. DOMBROWSKI, author of many monographs on game animals, in Vienna, on September 3rd; in September, at Saint-Gilles, Belgium, F. MÜLLER, Honorary President of the Brussels Linnæan Society, aged 77; T. MARGÓ, Professor of Zoology and Anatomy in Budapest University, on September 6th, aged 80; on September 10th, H. v. FOULLON, the geologist accompanying the Austrian "Albatros" scientific expedition, murdered in the Solomon Islands by the natives; EMILE RENBAUGH, a German naturalist, by an accidental fall on the Sierra Madra Mountains, Mexico; H. D. VAN NOSTRAND, a conchologist, who possessed a very valuable collection of shells, at New York, on October 9th; the American botanist, W. H. GIBSON, in July; Dr. C. E. BROWN-SEQUARD, a scientific worker, at Atlanta, Ga., aged 30; J. B. LEMBERT, entomologist, murdered at the Merced River, California; Dr. CALLENDER, Professor of Neurology at the Vanderbilt University, Nashville, U.S.A.; on February 18, E. GIOVANARDI, Professor of Descriptive Anatomy at Modena University; on July 5, MAURICE CHAPER, a student of Mollusca, at Paris; on October 19, Dr. R. KERRY, director of the bacteriological laboratory at the Veterinary Institute of Vienna; on November 16, aged 76, Admiral Sir GEORGE H. RICHARDS, F.R.S., who between 1864 and 1874 was Hydrographer to the Navy; J. E. GRAY, Harkness Scholar of Cambridge University, who died at Naples on November 8, the day after his arrival to occupy the University's table at the Zoological Station.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

THE following appointments are announced:—Dr. A. D. Waller, to be Fullerian Professor of Physiology for three years, and Dr. A. Scott, to be Superintendent of the Davy-Faraday Research Laboratory of the Royal Institution; Dr. A. Hill, to the Chair of Anatomy at Cambridge; F. T. Howard, to be one of H.M. Inspectors of Schools, his place as Lecturer in Geology at University College of S. Wales, Cardiff, being taken temporarily by A. B. Badger; Dr. G. Winkler, to be Director of the School of Mines at Freiburg i. S.; Dr. H. Stuhr, to be Assistant in the Anatomical Institute at Breslau; Professor Bubnof, of Dorpat, to the Chair of Hygiene in Moscow University; Dr. S. Bianchi to be full Professor of Anatomy at Vienna; Dr. B. Boccardi, to be Associate Professor of Microscopical Anatomy in the University of Naples; Dr. J. Pantocsek, of Tavarnok, to be Director of the Land-Hospital in Pressburg, Hungary; Dr. V. Goldschmidt, to be Professor of Mineralogy in Heidelberg University; Dr. N. Andrussow, of St. Petersburg, to the Chair of Geology in Dorpat (Jurjev) University; J. de Winter, of the Zoological Garden at Antwerp, to be Superintendent of the Garden at Gizeh, Cairo; Professor F. Berwerth, to be Director of the Mineralogical Department in the Natural History Museum, Vienna, in place of Dr. A. Brezina, retired; F. Nansen, to be Professor and Curator of the Biological Institute in Christiania; M. B. Waite, to be Professor of Botany in the Graduate School of Georgetown University; Dr. C. A. Scott, to the Chair of Experimental Psychology and Child Study at the Chicago Normal School; Dr. Guy Tawney, of Leipzig, to be Demonstrator of Experimental Psychology in Princeton University; O. F. Cook, to be Curator of the Cryptogomic Collections of the National Herbarium, U.S.; W. J. V. Osterhout, to be Lecturer in Botany in California University in place of Mr. A. Howe, resigned; A. W. Grabau, to be Assistant in Geology, S. C. Prescott and A. W. Weysse, to be Instructors in Biology, G. H. Barton, to be Professor of Geology in the Massachusetts Institute of Technology; Dr. R. M. Bolton, of Philadelphia, to be Instructor in Bacteriology at Missouri University; Dr. H. M. Knower, to be Instructor in Biology at Williams College, U.S.A.; H. C. Prinsen-Geerligs, to be Director of the Experiment Station in Java. We are pleased to note that Mr. R. J. Etheridge has been assisting his father in the arrangement of the geological collections of the Australian Museum.

ON the occasion of the opening of the new Gatty Marine Laboratory at St. Andrews on October 30, Sir William Flower, who attended as Director of the Natural History Museum, Canon H. B. Tristram, Professor G. Gilson, and Dr. Michael Foster, were made LL.DD. of that University.

PROFESSOR GUSTAF RETZIUS was made honorary M.D. of the University of Würzburg on the occasion of the opening of the new University buildings.

A MEMORIAL statue to Dr. H. Burmeister is being erected by subscription in Buenos Ayres to commemorate his long and important services to science, and especially to the National Museum. We understand that the Argentine Government has refused permission for it to be set up in a public place, on the ground that Dr. Burmeister was a foreigner; and it is thus destined to occupy an honoured position in the hall of the University.

A NANSEN Fund for scientific research has been established, and nearly £17,000 has already been subscribed. It is said that Nansen himself may be appointed director of the fund, which will be under the care of the Christiania University, the Norwegian Society of Science, and the Bergen Museum. Contributions may be sent to the committee of the fund at Christiania University.

WE are glad to see that the Austrian Government is taking measures to admit women next year to all faculties, except theological, of the universities, and also to grant those lady physicians who had obtained degrees at foreign universities the right of practising after having undergone examination in Austria.

THOSE in charge of the Essex Technical Laboratories are printing in their *Journal* papers on practical work in Animal Life on the Farm. These are simple demonstrations on the parts of Invertebrata, with notes on harmless or noxious characters of the animals noticed, and should be of much service to farmers and others.

A NEW Pathological Laboratory, adequately equipped at a cost of over £15,000, has been added to the Western Infirmary at Glasgow. Private working rooms for original researches, as well as a large museum, are provided.

THE fund for establishing a Pasteur Institute in India, has, we learn from *Nature*, reached the sum of 70,000 rupees, besides an annual income of 4,373 rupees. With 50,000 rupees more, work might soon be started in a fully equipped building.

AT Algiers, France, there has been established a bacteriological laboratory, with an appropriation of about £100 per annum.

WE learn from *Science* that the building in connection with the Massachusetts General Hospital, Boston, will soon be ready; it includes laboratories for chemistry, bacteriology, and histology.

THE Neild Collection of Coal-Measure fossils, collected mostly in the neighbourhood of Oldham, has been given to the Oldham Corporation, and is to be arranged in Oldham Museum, to illustrate the geology of that district, by Mr. H. Bolton, of Owen's College Museum. The mineral collection is also being put into order, and the whole plan allows of a typical geological collection being developed, somewhat on the lines of that at Perth.

THE Manchester Museum has just acquired the collection of Lancashire Coal-Measure Fossils made by Mr. George Wild, one of the most thorough and painstaking geologists of the county. It is a large collection, contains several types, and almost every specimen is labelled with locality, horizon, date of collecting, etc. The data are very full. The collection includes about 300 sheets of Coal plants, many bearing the successive slice of coal-ball to some of those described by the late Professor Williamson, who was dependent in a large measure for his material on Messrs. Wild, Neild, and Butterworth.

WE are glad to hear that the Corporation of Liverpool has just voted a sum of £72,000 for the extension of the Derby and Mayer Museums. Since the extension will be along the downward slope of the hill, it will permit the two lower floors to be used for technical schools, so that the whole sum mentioned is not entirely devoted to museum purposes. We have been waiting for some time to hear what was to be done about the proposed Zoological Gardens in Liverpool. It is now some months since, at a preliminary meeting held in Liverpool on June 11, Professor Herdman moved: "That in the opinion of this meeting it is desirable, in the interests of science and education in this city, to establish zoological gardens, containing a

collection of living animals, and that those present form a committee, with power to add to their number, for the purpose of advancing this object." This was carried unanimously, and a sub-committee was appointed to make enquiries for a suitable site. The site that it is now desired to acquire is in Sefton Park, and for this purpose a sum of at least £20,000 is needed. Liverpool certainly seems an excellent place in which to start a zoological garden, since it is in such direct communication by means of its trade with all parts of the world. It appears, moreover, to be a healthy place for exotic animals, so far as one can judge from those which live well enough in Mr. Crosse's well-known collection. We hope, therefore, that the money will soon be subscribed.

THE report of the trustees of the Australian Museum, Sydney, is chiefly remarkable for the record of 2,231 Mollusca added to the collections in 1895. Among the donors, the chief is Mr. W. A. Horn. A large collection of fossil Bryozoa was presented by Mr. R. Etheridge, jun. The usual want of funds has prevented the trustees from acquiring many specimens of great value, and this same want has seriously stopped collecting work, from which alone one can acquire duplicates to exchange with other institutions. One of the most important acquisitions during the year was one of Captain Cook's original MS. journals, the Log of the "Endeavour," presented by Mr. F. H. Dangar. A curious and unfortunate event was the destruction of the entire roof over the central part of the main building by white ants. This had to be shored up immediately on discovery, and the erection of a new roof will at once be proceeded with. The literature received by the library is printed in full catalogue manner, and thus admits of the cutting up of two copies, so as to form a card catalogue. This is an excellent arrangement and worthy the attention of other museums. The printing of the author's name in full to each entry, instead of using the repeat dash, would facilitate the arrangements considerably, and in but a few instances would extend the entry over another line. We are glad to note that, despite reductions in other directions, an official photographer is still attached to the staff, and a proper printing press with all plant necessary for the printing of labels will be in full working order next year.

THE Institute of Jamaica, to judge from its Report for the year ending March, 1896, is in a flourishing condition. The museum has been removed from the lower floor of Date Tree Hall to adjoining new premises. These consist of two floors, the lower devoted to the collections of the Government Geological Survey, the Jamaica woods, and most of the natural history collections; the upper floor filled with the anthropological and the rock and mineral collections. By reason of these changes the library accommodation has been greatly increased, and the art department given room to develop. An attempt has been made to increase the public interest in the museum and natural history generally by the publication of museum notes in the Kingston newspapers. There has been an increase of 28 per cent. in the attendance of visitors to the museum.

A MUSEUM of Arts and Sciences is being built by the Brooklyn Institute.

A MUSEUM of natural history has recently been established at Providence, R.I. Mr. James M. Southwick has been appointed Curator, and his object is to obtain collections representative of the local fauna, after which he hopes to form small loan collections for educational purposes.

THE Geo. H. Cook Museum of Geology in Rutger's College Museum, New Jersey, U.S., is described by its assistant curator, W. S. Valiant, in *Science* for October 16th. Several collections, including over 12,000 specimens of minerals, occupy part of the museum, which also contains large collections of recent molluscs,

botanical collections, fossil tree-trunks, and a case of Ellenville quartz crystals, which the curator describes as a "gem." In the museum, which is open free daily, a collector and student of forty years' experience is constantly in attendance to answer any questions pertaining to the collections.

THE Berlin Botanical Museum will be enlarged by leasing seven rooms in a neighbouring building; these are required for research work, and for the rapidly-increasing collections.

THE Royal Society has awarded its medals this year as follows:—The Copley Medal to Professor C. Gegenbaur, for his researches in comparative anatomy, especially on the history of the vertebrate skeleton; the Rumford Medal to Professors P. Lenard and W. C. Röntgen, for their investigation of the phenomena produced outside a highly exhausted vacuum tube through which electrical discharge is taking place; a Royal Medal to Sir A. Geikie, on account of his many original contributions to geology; a Royal Medal to Professor C. V. Boys, for his invention of quartz fibres and investigation of their properties, his improvement of the radio-micrometer and investigations with it, for developments in instantaneous photography, and for his determination of the value of the constant of attraction; the Davy Medal to Professor H. Moissan, for the isolation of fluorine and the use of the electric furnace in the preparation of refractory metals; the Darwin Medal to Professor G. Grassi, for his important discoveries, especially on matters related to Darwinism.

THE Geological Photographs Committee of the British Association calls attention to the fact that no less than 1,408 photographs were received up to August, 1896. These represent an extremely valuable series of records of sections, both temporary and permanent, of the rocks of this country, and can be referred to at the Museum of Practical Geology in Jermyn Street. Circular No. 7, issued by the committee gives further instructions and suggestions as to the kind of photographs desired, and we would urge upon all our geological and photographical readers the importance of preserving such valuable records of sections exposed from time to time in their own districts. Mr. W. W. Watts (28 Jermyn Street, S.W.) will furnish the circular to anyone interested.

AT the opening meeting of the session of the Geological Society of London, the President announced that Lady Prestwich, in fulfilment of the terms of a bequest of her late husband, had offered to the society 260 bound volumes of geological tracts from his library; also that £800 had been bequeathed to the society by Sir Joseph Prestwich, the interest to be applied to the triennial award of a medal and fund: this bequest to take effect subsequent to the decease of Lady Prestwich.

The electric light has been installed in the apartments of this society at Burlington House, and this was formally inaugurated on November 25, when the President and Council were at home to Fellows from 8.30 to 11.0 p.m. Many specimens of geological interest were exhibited, and smoking was permitted. *Lumina mutantur, et nos mutamur in illis.*

THE Soirée of the Geologists' Association, London, was held on Nov. 6. The chief objects of interest were a large series of flint implements shown by Messrs. E. T. Newton, Benjamin Harrison, Dr. Alex. Mitchell, Dr. F. Corner, and Robert Elliott. Considerable interest was aroused by specimens of *Uintacrinus*, newly discovered by Dr. Rowe and others in the English Chalk, and exhibited and explained by Mr. F. A. Bather.

THE meeting-room of the Zoological Society, on November 17, contained a large assemblage of live-stock. Mr. Chalmers Mitchell introduced a fox-terrier puppy as a probable case of telegony, the sire of a previous litter having been a dachshund; but Sir Everett Millais maintained that the puppy was merely a throw-back to the beagle ancestors of the fox-terrier stock. Both Sir Everett and Mr. Tegetmeier

refused to admit telegony. Mr. Leonard Hill showed some of the guinea-pigs on which he had repeated some of the experiments of Brown-Séquard, previously repeated by Romanes (see NATURAL SCIENCE, vol. viii,, p. 286); he had failed to prove the inheritance of a character produced by mutilation, the droop in the left eyelid of guinea-pigs whose parents had had the left cervical sympathetic divided turning out to be due to ophthalmia, from which a guinea-pig may suffer as well as a man.

THE annual course of Christmas lectures, specially adapted for children, at the Royal Institution this year will be delivered by Professor Silvanus Thompson, F.R.S., on "Visible and Invisible Light."

THE presentation of the first Bolitho Medal to Mr. Robert Etheridge, sen., is a peculiarly graceful act. We believe it has been recorded that Mr. Etheridge literally sat down and wept over the geology of the Devon and Cornish area when first he attempted to solve its mysteries, but having dried his tears, finally produced the famous paper which unlocked many of its secrets. The medal is of gold and is awarded by the Royal Geological Society of Cornwall.

THE Hull Scientific and Field Naturalists' Club (Secretary, T. Sheppard, 78 Sherburn Street), has an attractive programme of lectures for the current session. Those that are something more than the usual type delivered to a local society appear to be "Recent Progress in Local Entomology," by J. W. Boult and J. Porter, and "The Development of an English Village" (with local examples), by J. R. Boyle.

THE activity of Norwich as a centre of scientific work is well known, and the pages of scientific literature have always provided a goodly string of Norfolk men, especially in geology. Mr. James Moltram, in the last part (vol. vii., pt. 2) of the *Trans. Norfolk and Norwich Naturalists' Soc.*, has now given us a history of the Norfolk and Norwich Microscopical Society. This body was founded by W. K. Bridgman, Rev. J. Crompton, Thos. Brightwell, Rev. J. Landy Brown, and Arthur Morgan in 1852 and lasted until 1884. The Society did not itself publish, but the papers of its members found a place in other journals. It will be sufficient to mention that among its members were Frederick Kitton, Donald Dalrymple, Elijah Bleakley, H. G. Grasspoole, Francis Sutton, and J. B. Bridgman.

IT is pleasing to learn that the Royal Photographic Society's Exhibition was exceedingly well attended this year. Numerous excellent skiagraphs were shown, one of the thorax, showing the outline of the heart distinctly; several photographs of plants and flowers; also microphotographs of scientific and technical interest.

THE Geological Society of Stockholm has completed twenty-five years of active life, and the fact is commemorated in a special number of its Förhandlingar (No. 173), to which contributions have been made by A. E. Nordenskiöld, A. E. Törnebohm, L. Holmström, F. Svenonius, Hj. Sjögren, M. Weibull, H. Bäckström, J. J. Sederholm, G. Holm, and A. G. Nathorst.

THE next International Congress of Criminal Anthropology will meet in 1901 at the Hague, by invitation of the Dutch Government.

AS we have already stated, the International Conference, held under the auspices of the Royal Society to consider a catalogue of Scientific Papers, decided that the International Catalogue of Scientific Literature to be begun in 1900, should relate to

pure science only. The Federated Institution of Mining Engineers of Newcastle, however, is anxious for a Conference to consider the possibilities of preparing a Catalogue of the technical literature of Applied Science, and desires those interested in the scheme to communicate with the Secretary, Mr. Walter Brown, Neville Hall, Newcastle. Other matters, such as the postage on serials, it is suggested, might be also discussed.

THE Welby Prize of £50 is offered for the best treatise of practical utility on the causes of the present obscurity and confusion in psychological and philosophical terminology, and the directions in which we may hope for an efficient practical remedy. Competition is open to those who, previously to October 1, 1896, have passed the examinations qualifying for a degree at some European or American university. The essays, in English, French, or German, must be type-written and at least 25,000 words in length; they should be headed by a motto, and accompanied by a sealed envelope containing the name of the writer. MSS., to arrive before October 1, 1897, may be sent to Professor James Sully, London; Mr. G. F. Stout, Aberdeen; Professor O. Külpe, Würzburg; or Professor E. B. Titchener, Cornell University, Ithaca, N.Y. A French member will shortly be added to the Committee.

AMONG the free lectures being delivered under the auspices of the Leigh Browne Trust and the Humanitarian League, at St. Martin's Town Hall, is one by J. Arthur Thomson on "The Humane Study of Natural History," on December 8, at 8 p.m. The series was begun by Mr. Edward Carpenter, whose remarks we would comment on, if we could understand them.

DR. T. N. TSCHERNYSCHEW, of the Russian Geological Survey, has completed his observations on Nova Zembla. This island bears traces, like those in North Russia, of a formidable glaciation, followed by subsidence, during which the whole territory was transformed into an archipelago. Terraces, containing the shells of arctic molluscs, extend along the shores to a height of 160 metres. The present glaciers are in a period of growth.

A PORTION of the bequest made to the Swedish Academy of Sciences by A. F. Regnell, whose fortune was made as a physician in Brazil, was set aside by the academy to promote the study of the Brazilian flora. Every six years it yields about £1,150, which is applied in sending two Swedish botanists to Brazil for two years. The first expedition was undertaken by Drs. C. A. M. Lindman and G. O. A. Malme, who in 1892–94 explored Rio Grande, Paraguay, and Matto Grosso.

A SPANISH explorer, P. Joaquin Juanola, has discovered a lake, occupying the crater of an extinct volcano, in the island of Fernando Po, 1,330 metres above sea level. Monkeys and ducks are abundant round its banks, and it is said that the other members of the party saw a hippopotamus. This is very important, says the *Revue Scientifique*, and should be verified, for it must have been easy for the animal to swim to Fernando Po from Africa, if it really swam from Africa to Madagascar, as Dr. Blanford maintains.

PROFESSOR F. REGEL, of Jena, went to Columbia last July on a voyage of exploration, to last some nine months.

M. MAINDRON, the entomologist, has been commissioned by the French Government to make a collecting expedition to the Persian Gulf and India.

MR. E. A. ANTHONY, who was sent to Lower California by the Smithsonian Institution, is returning with large collections of shells, marine and terrestrial fauna and flora, containing many new species.

Mr. C. H. Sternberg has made a fine collection of fossil plants in the Dakota Group at Kansas.

Professor D. G Elliott has made good faunal collections in Somaliland.

Large collections of plants and animals from the north-eastern shores of Lake Nyasa, have been made by Mr. A. White, who has just returned to British Central Africa from a successful expedition into the Nyika plateau.

A CORRESPONDENT of the *Daily Chronicle* of November 10th points out that Nansen's deep layer of warmer and salter water below the surface of the Polar Sea, originating probably in the Gulf Stream, with a temperature of 1° above freezing-point, confirms the observations made by Leigh Smith in 1871, 1872, and 1873, that warm undercurrents from the Gulf Stream ran along the north-western coast of Franz Josef Land.

DR. NANSEN is having a new yacht built by Mr. Colin Archer, for the purpose of taking soundings around the coast-line of Norway and Spitzbergen.

A REGULATION that will help to preserve big game in German East Africa has been drawn up. This provides for shooting licences, prohibits the shooting of all young or female game, and levies a tax of 100 rupees on the first elephant shot, and 250 for each succeeding one. These restrictions do not apply to animals shot for food, or to apes, wild boars, reptiles, or beasts of prey. Special game-preserves in the interests of science will be established, and hippopotamus reserves are suggested.

DR. KOCH, the bacteriologist, has been ordered to the Cape by the German Government to examine into and report upon the rinderpest.

MR. A. ALDER, of George Street, Brisbane, Queensland, is prepared to send full-size colored plaster casts of *Ceratodus forsteri*, Krefft, packed and shipped, for £3 10s.

IT was announced in NATURAL SCIENCE (vol. iv., p. 164, March, 1894) that the people of Shrewsbury intended to erect some memorial of the illustrious native of that town, Charles Darwin. The project, however, was delayed for want of funds, largely in consequence of the fall of St. Mary's spire (*tom. cit.*, p. 256). We now learn that the deficiency has been made good by the Shropshire Horticultural Society, and that a statue, to cost from £1,000 to £1,200, is to be erected in the town. Further, such money as may be subscribed by friends of science and well-wishers to the memorial will be applied to the foundation of a memorial scholarship.

CORRESPONDENCE.

The Determination of Fossils.

In your November number, and under the head of "Pavingstone Palæontology," you give your readers some excellent advice on the subject of the determination of fossils. You say that the description of new species should always be handed over to trained zoological specialists, and no doubt this is highly desirable and generally possible; but when you add, "even the mere determination of fossils has nowadays become, like the determination of recent animals and plants, a task for the specialist in taxonomy, and the lists that we constantly see issued in connection with stratigraphical papers can be proved (as Natural Science has before now proved some of them) to be lengthy aggregations of error," you make a very serious indictment without indicating a practical remedy.

I think I shall voice the feelings of most writers of such papers in saying that they would only be too delighted to follow your advice and to get all their fossils named for them by competent men. As you truly remark, "correct conclusions cannot follow from inaccurate premises," and it is most important that fossils should be accurately named; but those who write such papers know that it is very difficult to get this done: the author may obtain the friendly assistance of one or two specialists, but the greater number of his fossils he has to identify as best he can for himself.

Now, unfortunately, in your present issue, you confine yourself to saying that we are very worthy and energetic people, but that not being universal geniuses we ought not to attempt a task which is so much beyond our capacities. No doubt there is much truth in this, and we anxiously await your next issue, in which we hope that you will tell us where the specialists are to be found who are always ready to examine and name the fossils collected by anyone who is working at stratigraphical problems. The idea is magnificent, and an Editor is of course omniscient, so you are doubtless prepared to inform us how your advice can be carried out in practice: in so doing you will confer an immense obligation on more than one

Stratigraphical Geologist.

[We beg to refer the "more than one," who have written to similar effect, to our Article on page 361.—Ed. Nat. Sci.]

Indexes of Periodicals.

Surely some better method than the present one of indexing periodicals might be found. Take Natural Science, for example. It has only been in existence since March, 1892, and we already have eight volumes with eight separate indexes. To look up anything in these indexes is already troublesome, and in a few years will be a laborious business. Who can be expected to wade through the fifty-four indexes of your contemporary, *Nature*? If some means could be devised whereby each succeeding index could be incorporated with the pre-existing indexes, much trouble would be saved. This might, perhaps, to a certain extent, be accomplished if each index were printed on a series of cards of uniform size, each corresponding with a letter of the alphabet; then, when a new index appeared, all items beginning, say, with the letter G, could be arranged together, although not further classified. The index would then cease to be attached to each volume, and would become a key to the whole series of volumes. Of course, the number of volume would have to be printed on each card, and a uniform size of cards for all periodicals would be desirable.

Bernard Hobson.

Owens College, Manchester.

[Our correspondent's suggestion, though not precisely novel, is no doubt most valuable, but the publication of such an index is rather beyond the powers of such a journal as ours; for the present volume, for instance, no less than 1,000 slips have actually been made and kept for incorporation, but who is to pay for their publication and distribution? Will Mr. Hobson begin with a subscription of £5? No doubt the task would be easier for a serial that published nothing but articles, and that required at most 100 slips to each volume. While, therefore, we desire to help the modern indexing movement, we feel obliged to leave its actual carrying out to such an institution as the Concilium Bibliographicum at Zurich, or that International Central Bureau of still wider scope which everyone is hoping to see firmly established. But as for Mr. Hobson, we are quite ready to sell him *two* copies of the present number, so that he may cut up the index and paste it down for himself.—ED. NAT. SCI.]

MR. WALTER HOWCHIN writes to us from Adelaide that we have done him an injustice, on page 10 of our July number, in stating "We cannot accept the *Cornuspira* because of the chambering shown in the figure." In his description it is distinctly stated that the foraminifer is a "non-septate tube," and that the appearance of chambering is produced by the "irregular coiling of the earlier convolutions of the tube." We must apologise to Mr. Howchin for having overlooked this satisfactory explanation.

WE are unable to take notice of anonymous contributions, but if the gentleman who writes under the title of "A Constant Subscriber" will kindly give us his initials and address, we shall be glad to reply to him. Meanwhile, we may request him to compare the earlier and later numbers of NATURAL SCIENCE with more exactness, when he will find that several changes we have introduced have enabled us to give more matter than formerly in the corresponding space.

SPECIAL NOTICE.

REDUCTION OF ANNUAL SUBSCRIPTION:—*Owing to the lower rate of postage, we are now prepared to send each number direct to any address in the Postal Union, immediately on publication, for an annual subscription of* 13s. ($3 *in America*), *or the equivalent in foreign money. Subscriptions for* 1897 *are now payable.*

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JULY, 1896.

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